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Draft Environmental Impact Statements

Wasatch County Water Efficiency Project and Daniel Replacement Project

Central Utah Water Conservancy District

Provo River Restoration Project

Utah Reclamation Mitigation and Conservation Commission

Utah Reclamation
Mitigation and
Conservation
Commission

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

June 1996

Preface

This document contains two Draft Environmental Impact Statements (DEIS): the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) DEIS, and the Provo River Restoration Project (PRRP) DEIS. The first DEIS covers the WCWEP and DRP; the second DEIS covers the PRRP. The WCWEP and DRP DEIS was prepared by the Central Utah Water Conservancy District (CUWCD), pursuant to the Central Utah Project Completion Act (CUPCA) Public Law 102-575, of 1992. The Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) prepared the PRRP DEIS with the assistance of the CUWCD.

Each DEIS has a signature page, cover sheet, table of contents, summary and four chapters. Following a divider page, the WCWEP and DRP DEIS starts with a cover sheet, followed by a signature page, table of contents, and the WCWEP and DRP Summary section, which summarizes the highlights of each chapter. Chapter 1 describes the Proposed Action and alternatives, including the purpose and need. Chapter 2 provides a comparative analysis among the Proposed Action and alternatives. Chapter 3 describes the affected environment and environmental impacts of the Proposed Action and alternatives. Chapter 4 describes the consultation and coordination performed by the CUWCD throughout the environmental analysis and preparation of the DEIS. The PRRP DEIS starts after another divider page, followed by a cover sheet, signature page, table of contents and the PRRP Summary section summarizing the highlights of each chapter. The PRRP DEIS also has four chapters that serve the same purposes as the WCWEP and DRP DEIS chapters. Portions of the PRRP DEIS chapters are referenced back to identical sections in the WCWEP and DRP DEIS to avoid duplication. The References Cited, Glossary and Acronyms and Abbreviations are common to both DEISs and follow Chapter 4 of the PRRP DEIS. Appendices follow the Acronyms and Abbreviations section. Oversized maps referenced in both DEISs are in pockets at the back of the DEIS.

Page numbers in the WCWEP and DRP DEIS are preceded by a “W” followed by the chapter or section number and specific page number. Page numbers in the PRRP DEIS are preceded by a “P,” also followed by the chapter or section number and specific page number. Tables, figures and maps in the DEISs follow the page they are first referenced, except for the oversized maps in pockets at the back of the DEISs.

Draft technical reports supporting the DEIS have been prepared for the following resources: Water Resources, Water Quality, Wetlands, Aquatic Resources, Threatened and Endangered Species, Wildlife Resources (PRRP only) and Cultural Resources. Copies of the DEISs and draft technical reports are available from the following address:

Nancy Hardman
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058
Telephone: (801) 226-7187
Fax: (801) 226-7150

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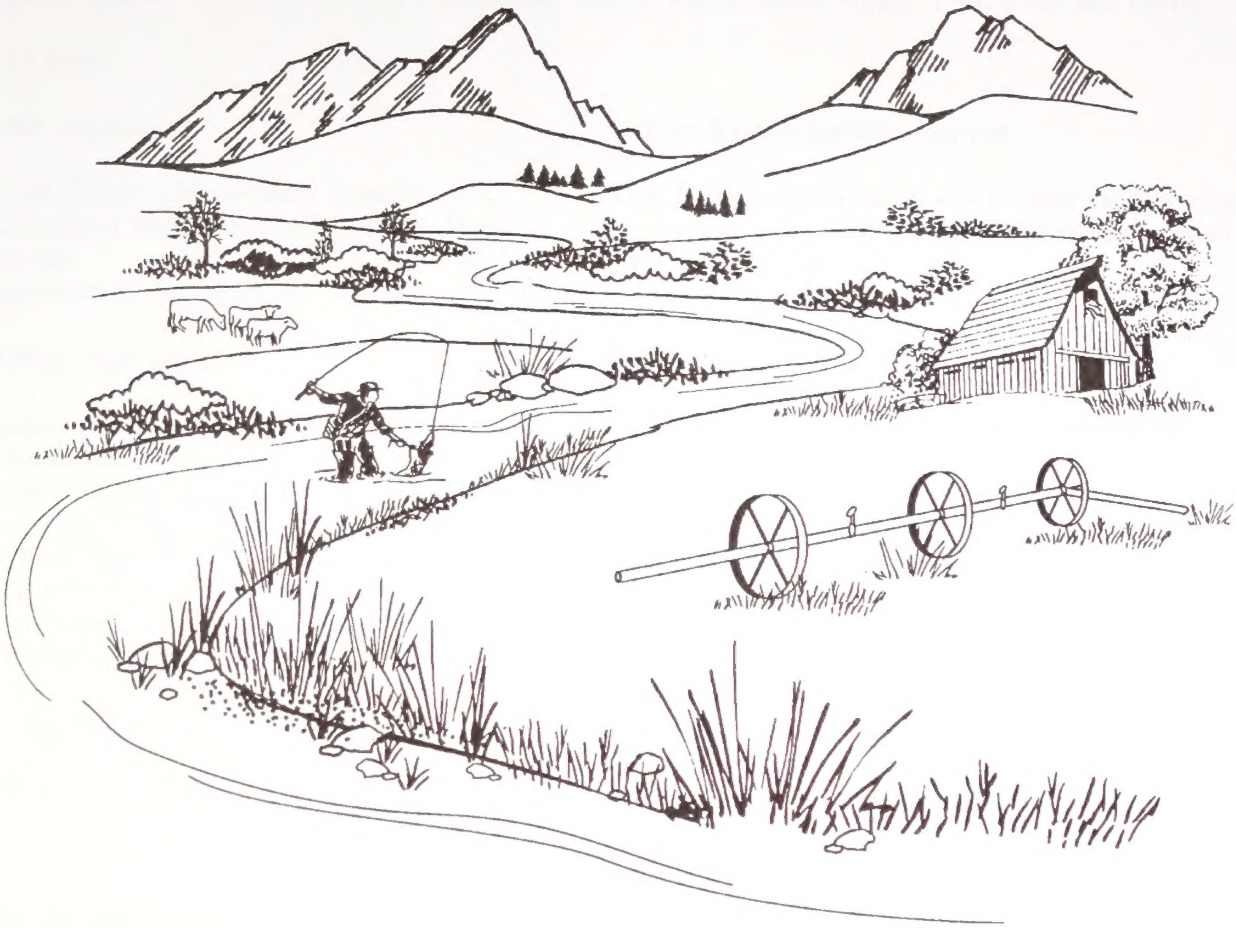

Wasatch County Water Efficiency Project and Daniel Replacement Project

Central Utah Water Conservancy District (Lead Agency)
Utah Reclamation Mitigation and Conservation Commission (Joint Lead Agency)
U.S. Department of the Interior (Joint Lead Agency)

Utah Reclamation
Mitigation and
Conservation
Commission

Draft Environmental Impact Statement

MARCH 3, 1849

June 1996

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COVER SHEET

Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP)

(X) Draft ( ) Final

Joint Lead Agencies

Central Utah Water Conservancy District
Utah Reclamation Mitigation and Conservation Commission
U.S. Department of the Interior

Cooperating Agencies

U.S. Department of Army, Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Department of Agriculture, Forest Service
Utah Department of Natural Resources
Wasatch County Special Service Area No. 1

Counties that Could be Affected

Wasatch and Utah, UT

Abstract

This Draft Environmental Impact Statement (DEIS) covers two proposed federal projects (Wasatch County Water Efficiency Project and Daniel Replacement Project) in Wasatch County, Utah. The Proposed Action (Wasatch County Water Efficiency Project With Daniel Replacement Pipeline) would replace water currently diverted from the upper Strawberry River basin by Daniel Irrigation Company (DIC). Replacement water would be supplied by water conserved from providing pressurized water that would make it possible for farmers to convert from flood irrigation to sprinklers. Conserved water also would be used to supplement flows of five Heber Valley streams. Two alternatives (DRP With Pipeline and DRP With Canal) would provide different conveyance facilities for the DIC replacement water. The No Action Alternative would not change DIC diversions, water efficiency and instream flows. Major environmental issues involve water resources, water quality, wetlands, aquatic resources, wildlife, threatened and endangered species, agriculture, socioeconomics and recreation resources.

Other Requirements Served

This DEIS is intended to serve other environmental review and consultation requirements pursuant to 40 CFR 1502.25 (a).

DEIS Contact

Comments on this DEIS should be directed to:

Karen M. Ricks, Project Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058

Date DEIS Made Available to EPA and the Public:

June 10, 1996

Date by Which Comments on the DEIS Must be Received to be Considered in the Preparation of the Final Environmental Impact Statement:

August 13, 1996

Central Utah Water Conservancy District

355 WEST 1300 SOUTH OREM, UTAH 84058
TELEPHONE (801) 226-7100

June 10, 1996

Dear Reviewer:

These Draft Environmental Impact Statements (DEISs) on the proposed Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) and the proposed Provo River Restoration Project (PRRP) were filed with EPA June 10, 1996 and are submitted for your review and comment. The purpose of this public review is to receive your comments on the information presented in the DEISs. Final Environmental Impact Statements (FEISs) will be prepared considering the comments received and will be sent to those who have commented on the DEISs or who request a copy. The FEISs may only include errata sheets and responses to comments; therefore, you should retain your copy of the DEISs.

Please submit your written comments so that they are received by August 13, 1996. Comments received by this date will be responded to in the FEISs. Please make your comments as specific as possible, and provide rationale or data to support your position. Comments will be most helpful if they address the inadequacies or inaccuracies in the impact analysis or methodologies used or identify new impacts or recommend reasonable new alternatives or mitigation measures that may have been overlooked.

Written comments on the WCWEP and DRP DEIS should be addressed to:
Karen M. Ricks, Project Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, UT 84058-7303

Written comments on the PRRP DEIS should be addressed to:
Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission
355 West 1300 South
Orem, UT 84058-7303

Comments on the DEISs also may be presented verbally or submitted in writing at a public hearing. Public hearings have been scheduled for July 16, 1996, at 6:00 pm in the Wasatch County Middle School Little Theater, 800 S. 200 E., Heber City, Utah; and July 17, 1996, at 6:30 pm in the Salt Lake County Commission Chambers (Room N1100), 2001 S. State Street, Salt Lake City, Utah. If you wish to give testimony at the hearing, please fill out a hearing registration form (included at the end of the DEISs) and return it to our Orem office (listed on the form and below).

These DEISs contain information summarized from the following draft technical reports: *Aquatic Resources, Water Quality, Cultural Resources, Water Resources, Wetlands, Threatened and Endangered Species,* and *Wildlife Resources*. Please send hearing registration forms and/or requests for copies of the technical reports or DEISs to: Nancy Hardman, CUWCD·355 West 1300 South·Orem, UT 84058-7303·(801) 226-7187·FAX (801) 226-7150.

Sincerely,

Karen M Ricks
Karen M. Ricks, Project Manager
Central Utah Water Conservancy District

Michael C Weland
Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission

U.S. DEPARTMENT OF THE INTERIOR

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
ON THE
WASATCH COUNTY WATER EFFICIENCY PROJECT AND DANIEL REPLACEMENT PROJECT

Prepared by
Central Utah Water Conservancy District
June 1996

Don A Christiansen

Don A. Christiansen, General Manager
Central Utah Water Conservancy District

Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission

Ronald Johnston

Ronald Johnston, CUPCA Program Director
U.S. Department of the Interior

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*Are included in pocket at back of EIS

Summary

The following sections summarize each chapter of the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) Environmental Impact Statement (EIS). This summary describes the purpose and need, major differences for key resources between the impacts of the Proposed Action and alternatives, major impact conclusions of the EIS and key consultation and coordination activities. This summary also describes areas of controversy or concern, issues to be resolved and the preferred alternative.

S.1 Chapter 1 – Description of the Proposed Action and Alternatives

S.1.1 Purpose and Need

The Proposed Action and alternatives would respond to the following needs:

- To restore flows in the upper Strawberry River that have been diverted by the Daniel Irrigation Company (DIC)
- To provide water and water conveyance facilities from Jordanelle Reservoir to the existing Daniel Irrigation Company (DIC) water storage facilities

Restoring flows in the upper Strawberry River basin was identified as the highest priority aquatic mitigation measure in the Aquatic Mitigation Plan for the Strawberry Aqueduct and Collection System (U.S. Fish and Wildlife Service 1988). This measure would compensate for the loss of trout-spawning habitat and stream fishing opportunities caused by inundation when Strawberry Reservoir was enlarged.

Congress recognized the need to replace DIC's transbasin diversions to help restore natural flows in the upper Strawberry River basin. It instructed the Central Utah Water Conservancy District (CUWCD) "to construct a pipeline from the Jordanelle Reservoir to the existing DIC water storage facilities for the purpose of providing a permanent replacement supply of water in an amount equal to the Strawberry Basin water..." (Section 303(b)(3)(A) of the Central Utah Project Completion Act [CUPCA] of 1992).

Following are the purposes of the Proposed Action and alternatives:

- To improve efficiencies, conserve water and improve water management in Heber Valley by constructing water management facilities under Sections 202(a)(3) and 207 of CUPCA
- To supplement flows in some Heber Valley streams through conservation and efficiency measures to improve environmental and recreation resources
- To protect the water rights of downstream users
- To minimize costs of project features
- To minimize adverse impacts on groundwater, wetlands and other environmental resources
- To return the portion of the Strawberry River and its tributaries affected by the DIC diversion facilities to a naturally functioning state

S.1.2 Description of the Proposed Action and Alternatives

S.1.2.1 The Proposed Action: Wasatch County Water Efficiency Project With Daniel Replacement Pipeline

Map A-1 (see pocket at back of EIS) shows the location of the major physical features of the Proposed Action, which would replace water currently diverted by DIC from the upper Strawberry River basin. Conserved water would be used to provide replacement water for DIC. The replacement water would be diverted at the Timpanogos Diversion on the Provo River near Jordanelle Reservoir and conveyed through the Timpanogos Canal, and new pumping stations and pipelines. Diversions from the upper Strawberry River basin would stop once the Proposed Action is implemented.

The Proposed Action would help improve water use efficiency in nine of the 12 Heber Valley irrigation companies, where pressurized water would facilitate farmers converting from flood irrigation to sprinklers. Although not part of the Proposed Action, on-farm conversion to sprinkler irrigation systems would occur during construction, with funding provided under Public Law 83–566 (Watershed Protection and Flood Protection Act). Financing would be administered by the Natural Resources Conservation Service (NRCS) as it implements the Tri-Valley Watershed Plan. Conversion to sprinkler irrigation would reduce average annual water use in affected areas from about 5 to 7 acre-feet to 3 acre-feet per acre.

The Proposed Action would deliver pressurized water to irrigation company service areas through pipelines extending from the Timpanogos, Wasatch and Humbug canals. Pumps along these canals would pressurize water for nearly all land with water efficiency improvements at elevations above the Sagebrush and Spring Creek Canal. Land at lower elevations would be served by gravity pressure.

The Proposed Action would replace some distribution canals with pipeline, which would directly conserve water by improving the efficiency of the Heber Valley irrigation conveyance system.

Water conserved under the Proposed Action would be used to supplement flows of five Heber Valley streams: Rock Ditch, Spring Creek, lower Lake Creek, London Ditch and Creamery Ditch. Map A-1 (see map pocket at back of EIS) highlights the stream reaches that would receive supplemental flows.

The Proposed Action includes pumping facilities that would allow Heber City to pressurize water for irrigation of lawns and gardens. The city would construct a buried pipeline system to replace small dirt ditches now used to convey irrigation water.

Under the Proposed Action and DRP alternatives, DIC diversion facilities would be abandoned and removed, and natural streamflows in the upper Strawberry River basin and its tributaries would be restored after the transbasin diversion to Daniels Creek is terminated. Removal of the DIC diversion facilities in the upper Strawberry River basin after the transbasin diversion is terminated would improve environmental conditions and minimize public safety hazards. This part of the Proposed Action would include stabilizing two headcuts and modifying existing canals, diversion facilities, reservoirs, a tunnel and siphon, stream gauges and roads. It also would include construction of a small buried pipeline within the existing canal network to deliver water to livestock watering troughs.

S.1.2.2 The Daniel Replacement Project With Pipeline Alternative

Map A-2 (see pocket at back of EIS) shows the location of major physical features of the Daniel Replacement Project alternatives. The DRP With Pipeline Alternative would replace water currently diverted from the upper Strawberry River basin by DIC with CUP agricultural water stored in Jordanelle Reservoir that would be diverted at the Timpanogos Diversion on the Provo River near Jordanelle Reservoir. This is the same location where it would be diverted under the Proposed Action. A new 11.9-mile-long pipeline with pumping stations would convey replacement water from the Timpanogos Diversion to the DIC service area. DIC diversion facilities in the upper Strawberry River basin would be removed as summarized above in Section 1.2.1. Unlike the Proposed Action, this alternative would not improve the efficiency of water use by Heber Valley's irrigation companies or supplement flows of the five streams to be enhanced under the Proposed Action.

S.1.2.3 The Daniel Replacement Project With Canal Alternative

The DRP With Canal Alternative would replace water currently diverted by DIC from the upper Strawberry River basin with CUP agricultural water stored in Jordanelle Reservoir. Map A-2 (see pocket at back of EIS), shows that replacement water would be diverted at the Timpanogos Diversion and conveyed to the DIC service area through an enlarged Timpanogos Canal, new pumping stations and pipelines. Water currently conveyed by the Timpanogos Canal would continue to be conveyed and delivered by the enlarged Timpanogos Canal. DIC diversion facilities in the upper Strawberry River basin would be removed as described above in Section 1.2.1. Unlike the Proposed Action, this alternative would not improve the efficiency of water use by Heber Valley's irrigation companies or supplement flows of the five streams to be enhanced under the Proposed Action.

S.1.2.4 The No Action Alternative

Under the No Action Alternative there would be no change in water efficiency, instream flows, and canal capacities and operations in Heber Valley. There also would be no change in the operation of diversions from the upper Strawberry River basin to Daniels Creek, and baseline conditions would continue.

S.2 Chapter 2 – Comparative Analysis of the Proposed Action and Alternatives

This section summarizes the major differences between the impacts of the Proposed Action and DRP alternatives, which involve the Water Resources, Aquatic Resources, Wetlands, Agriculture and Socioeconomics resource topics.

S.2.1 Water Resources

Only the Proposed Action would provide pressurized water to Heber Valley farmers to facilitate their conversion from flood irrigation to sprinkler systems and increase water use efficiency. The Proposed Action would cause the greatest drawdowns of groundwater levels in Heber Valley. The source of water supply for the DRP under the Proposed Action would be conserved water within the Heber Valley. CUP agricultural water availability would not change. The source of water supply for the DRP under the DRP alternatives would be reallocated CUP agricultural water. CUP agricultural water availability would be reduced under the DRP alternatives. The Proposed Action would reduce water supply shortages, while the DRP alternatives would increase shortages of agricultural water supplies in the valley for all irrigation companies except DIC.

Unlike the DRP alternatives, the Proposed Action would supplement flows in London, Rock and Creamery ditches, Spring Creek and lower Lake Creek.

S.2.2 Aquatic Resources

The supplemental flows included in the Proposed Action would improve aquatic resources habitat in the five affected streams in Heber Valley, which would increase trout populations in these streams. Restoration of flows in the upper Strawberry River basin streams under the Proposed Action and alternatives (except for No Action) would enhance aquatic resources habitat and trout populations.

S.2.3 Wetlands

Groundwater drawdowns caused by the Proposed Action would adversely impact some wetlands in Heber Valley. However, it would cause an overall, net increase of wetlands since the increase in upper Strawberry River basin wetlands would be greater than the decrease in Heber Valley. The DRP alternatives would cause the same increase in upper Strawberry River basin wetlands as the Proposed Action without a decrease in Heber Valley wetlands. Therefore, the net increase in wetlands under the DRP alternatives would be larger than under the Proposed Action.

S.2.4 Agriculture

The Proposed Action and DRP alternatives would cause different impacts on the long-term productivity of agriculture in Heber Valley. The conversion to sprinkler irrigation facilitated by the Proposed Action would increase crop yields and productivity in the valley. The DRP alternatives would decrease the productivity of agriculture in the valley by reducing agricultural water supplies.

S.2.5 Socioeconomics

The direct impacts on agricultural productivity summarized above in Section S.2.4 would lead to different impacts on the economics of agricultural operations in Heber Valley. While farm revenue and profitability would increase under the Proposed Action, they would decrease under the DRP alternatives.

S.3 Chapter 3 – Affected Environment and Environmental Consequences

S.3.1 Areas of Controversy or Concern

This section summarizes the major areas of controversy or issues of concern identified by the public or agencies during scoping, or by the EIS team during the analysis. Two issues in addition to those summarized in the sections below were identified during the EIS analysis and are described in Section S.3.3. They involve finalizing the Daniel Replacement Water Contract and the non-federal cost-sharing requirement of CUPCA. Following are the major areas of controversy or issues of concern by resource:

S.3.1.1 Water Resources

- How would Daniel Creek flows be impacted by terminating transbasin diversions under the Proposed Action and DRP alternatives?
- Would the Proposed Action and DRP alternatives affect the supplies of water users?
- What would be the effects on groundwater levels and wells caused by converting from flood to sprinkler irrigation made possible by the Proposed Action?
- Would the Proposed Action and DRP alternatives reduce return flows from the Heber Valley groundwater basin to surface water?

S.3.1.2 Water Quality

- What effects would the redistribution of water in Heber Valley under the Proposed Action and DRP alternatives have on water quality in streams and Deer Creek Reservoir?
- What water quality impacts would occur in Daniels Creek once the Proposed Action and DRP alternatives eliminate the transbasin diversion?

S.3.1.3 Wetlands

- What would be the effects on wetlands from the irrigation conversion made possible by the Proposed Action?
- What other types of wetlands impacts would occur under the Proposed Action and DRP alternatives?

S.3.1.4 Aquatic Resources

- Could adequate fish habitat be maintained in Daniels Creek after the transbasin diversion is terminated under the Proposed Action and DRP alternatives?
- What would the impacts be on trout and the leatherside chub once the Proposed Action supplements streamflows in Heber Valley streams?
- What would be the impact of the Proposed Action and DRP alternatives on aquatic resources in the upper Strawberry River basin once the streams in the basin are restored?

S.3.1.5 Wildlife Resources

- What impacts would the Proposed Action and DRP alternatives have on wildlife in Heber Valley, Daniels Creek Canyon and the upper Strawberry River basin?

S.3.1.6 Threatened and Endangered Species

- What impacts would the Proposed Action and DRP alternatives have on spotted frogs, Ute ladies'-tresses and bald eagles?

S.3.1.7 Agriculture

- How would agricultural cropping patterns and operations be affected during and after construction of the Proposed Action and DRP alternatives?

S.3.1.8 Socioeconomics

- How would the agricultural impacts of the Proposed Action and DRP alternatives affect the local economy?
- How would an increase in recreation opportunities under the Proposed Action and DRP alternatives affect the local economy?
- Would the Proposed Action and DRP alternatives induce growth in Heber Valley?

S.3.1.9 Recreation Resources

- Could an adequate recreational fishery be maintained in Daniels Creek canyon once the transbasin diversions are terminated under the Proposed Action and DRP alternatives?

- How would the Proposed Action and DRP alternatives affect recreation in Heber Valley and the upper Strawberry River basin?

S.3.2 Major Impact Conclusions

S.3.2.1 Water Resources

The Proposed Action and DRP alternatives would terminate transbasin diversions from the upper Strawberry River basin to Heber Valley and the Provo River basin. This would increase flows in the Strawberry River and its tributaries and decrease average flows in Daniels Creek above the DIC diversion by 2,900 acre-feet (about 35 percent) during months when diversions currently occur. The Proposed Action would decrease water supply shortages in the Heber Valley by making it possible to improve water use efficiencies. The DRP With Pipeline Alternative would increase shortages for Heber Valley agricultural water users, except for DIC, by an average of about 24 percent as compared to baseline conditions because there would be less CUP agricultural water available to the water users. The DRP With Canal Alternative would increase shortages for the same users by an average of about 40 percent as compared to baseline. The Proposed Action would increase average monthly flows in London, Rock and Creamery ditches, Spring Creek and lower Lake Creek from about 0.6 to 16.9 cubic feet per second. After construction the Proposed Action combined with the on-farm Improvements accomplished under the Tri-Valley Watershed Plan would lower groundwater levels in Heber Valley. The largest reductions in groundwater levels would be about 40 to 60 feet in the southeast portion of Heber Valley. Some wells may become inoperable. Affected wells would be determined based on a groundwater monitoring program. On an average monthly basis, the Proposed Action would not reduce total Heber Valley inflow to Deer Creek Reservoir or in lower Provo River flows below Deer Creek Reservoir. The DRP alternatives would cause a minor reduction of about 1 percent in total average monthly Heber Valley inflow to Deer Creek Reservoir and about 3 percent in lower Provo River flows below Deer Creek Reservoir. Even though average monthly inflows to Deer Creek Reservoir are essentially unchanged, impacts to prior water users and water resources could result unless the corrective measures described in Chapter 1 Section 1.6 are implemented. These corrective measures would require that conserved water stored in Jordanelle be released when necessary to supplement diversions and flows on the lower Provo River.

S.3.2.2 Water Quality

The Proposed Action would reduce concentrations of nitrates, total suspended solids and total phosphorus in Provo River inflow to Deer Creek Reservoir by about 4 to 6 percent. The DRP alternatives would reduce such concentrations by about 11 to 12 percent. Total suspended solids and nitrate concentrations in Spring Creek, Lake Creek, London Ditch, and Creamery Ditch would be reduced by the Proposed Action, while the DRP alternatives would not affect these tributaries. Total suspended solids loads to Deer Creek Reservoir would decrease slightly during average and wet years and increase loads slightly during a dry year under the Proposed Action. The DRP alternatives would not change TSS loading during average and wet years and would slightly decrease loading during dry years. Eutrophication and mixing status in Deer Creek Reservoir would not be affected by the Proposed Action or DRP alternatives. Temperatures in Daniels Creek would either remain the same or decrease slightly once the transbasin diversions are terminated under the Proposed Action and DRP alternatives.

S.3.2.3 Wetlands

The Proposed Action and DRP alternatives would increase wet meadow, emergent marsh and shrub wetlands in the upper Strawberry River basin by about 76.4 acres after flows are restored in the basin's streams. The lowering of groundwater levels under the Proposed Action would indirectly convert about 20.7 acres of wet meadow, wetlands to upland. The Proposed Action would therefore cause a net increase in wetlands of about 53.6 acres. The DRP With Pipeline Alternative would directly disturb and restore about 6.9 acres of wetlands during construction. It would adversely and indirectly eliminate about 2.1 acres of riparian woodland. The net increase in wetlands under the DRP With Pipeline Alternative would therefore be about 74.3 acres. The DRP With Canal Alternative would directly disturb and restore about 6.1 acres of wetlands during construction and would indirectly and adversely eliminate about 2.1 acres. The DRP With Canal Alternative would therefore cause a net increase in wetlands of approximately 74.3 acres.

S.3.2.4 Aquatic Resources

The Proposed Action and DRP alternatives would increase trout populations in the upper Strawberry River basin by about 17,520 pounds, or 515 percent. A recreational fishery would be maintained in Daniels Creek under the Proposed Action and DRP alternatives because flows would be sufficient to maintain baseline stocking levels. However, the native trout population would be adversely affected. The supplemental flows included in the Proposed Action would increase trout populations in the five affected streams by about 1,616 pounds, or 221 percent. In Heber Valley, once the flows in five streams are supplemented, habitat conditions change to the detriment of the leatherside chub as trout populations increase. A survey would be conducted prior to construction to identify leatherside chub population centers in Heber Valley and to learn more about the status of this species.

S.3.2.5 Wildlife Resources

Construction of the Proposed Action and DRP alternatives would cause minor and temporary impacts on wildlife habitat in Heber Valley. A livestock watering system (which also would provide wildlife water) would be added as part of the rehabilitation of the Daniel Irrigation Facilities in the upper Strawberry River basin. The Proposed Action would cause a net increase of 53.6 acres of wildlife habitat and the DRP alternatives would cause a net increase of 74.3 acres. The increase in habitat would occur in the upper Strawberry River basin as additional wetlands are restored and enhanced.

S.3.2.6 Threatened and Endangered Species

The Proposed Action and DRP alternatives would not impact spotted frogs. Ute ladies'-tresses would not be directly impacted by the Proposed Action and DRP alternatives. The wetlands habitat that would be indirectly impacted by the Proposed Action is marginal Ute ladies'-tresses habitat that is not considered critical to survival. It also provides habitat for peregrine falcon prey. The Proposed Action and DRP alternatives would not adversely impact the June sucker in the lower Provo River. Bald eagles would benefit from increased trout populations.

S.3.2.7 Agriculture

The Proposed Action and DRP alternatives would cause a loss of animal unit months (AUMs), alfalfa and barley production during construction. The loss would range from approximately 1 to 3 percent of the total annual baseline production in the impact area of influence.

After construction the Proposed Action combined with the on-farm improvements accomplished under the Tri-Valley Watershed Plan would improve irrigation efficiencies. This would result in a 20 percent per year increase over baseline in crop yields and production of AUMs. Alfalfa production would increase by approximately 9 percent per year, while barley production would essentially remain the same as under baseline.

Implementation of the DRP alternatives would cause minor (1 to 2 percent) decrease from baseline levels in the annual production of AUMs and alfalfa.

S.3.2.8 Socioeconomics

Construction of the Proposed Action and DRP alternatives would increase gross revenue, income and employment in the construction and retail trade sectors of the local economy. The Proposed Action would cause a total decrease in agricultural gross revenue during construction of about $43,751 (2.5 percent). The DRP With Pipeline Alternative would reduce agricultural gross revenue during construction by about $15,972 (less than 1 percent). The reduction in such revenue under the DRP With Canal Alternative would be about $9,797 (less than 1 percent).

The Proposed Action combined with the on-farm improvements accomplished under the Tri-Valley Watershed Plan would increase farm revenue, income and profitability after construction as total gross revenue increases by about $130,885 a year (7.5 percent). Revenue and income in Heber Valley's retail trade sector would increase as recreationists spend money in the valley on their way to the upper Strawberry River basin. The total increase in gross revenue after construction would be about $316,000 a year (less than 1 percent of total Wasatch County revenue). Both DRP alternatives would cause minor decreases in farm revenue, income and profitability after construction. Gross agricultural revenue would decrease about $1,178 a year after construction (less than 1 percent) under the DRP With Pipeline Alternative and by about $17,117 a year (1 percent) under the DRP With Canal Alternative. The increase in recreation-related revenue and income caused by the DRP alternatives would be larger than the decrease in agricultural revenue and income. The DRP With Pipeline Alternative would cause an increase in total gross revenue after construction of about $118,000 a year (less than 1 percent of total Wasatch County revenue). The increase in total revenue under the DRP With Canal Alternative would be about $102,000 a year. The Proposed Action and DRP alternatives would not induce growth in Heber Valley or elsewhere.

S.3.2.9 Recreation Resources

Recreational opportunities would increase significantly in the upper Strawberry River basin once the basin's streams are restored under the Proposed Action and DRP alternatives, primarily an increase of about 10,000 angler days a year. The preservation of baseline trout stocking levels would help avoid reduced recreation levels along Daniels Creek. The Proposed Action would cause a minor increase in recreation along the five Heber Valley streams that receive supplemental flows. Fishermen wishing to fish these streams would need to receive permission from landowners since access would not be provided under the Proposed Action. UDOT may allow future public access to its property on Creamery Ditch, however there is no parking in this area, except for the road shoulder (Highway 40).

S.3.3 Issues to Be Resolved

S.3.3.1 The Daniel Replacement Water Contract

The Proposed Action and DRP alternatives cannot be implemented unless a contract between DIC and CUWCD is finalized that would define the terms and conditions by which replacement water is delivered to DIC once the transbasin diversion is terminated. The Water Resources analysis was conducted using assumptions that address the most likely terms and conditions in such a contract. Although the final terms and conditions will likely be the same as or very similar to the assumptions used in the analysis, the final outcome of ongoing negotiations is uncertain.

S.3.3.2 Non-Federal Cost-Sharing

Section 204 of CUPCA requires that the "non-Federal share of the cost of design, engineering, and construction of the Central Utah Project features authorized by Sections 202 and 203 shall be 35 percent of the total reimbursable costs." The Proposed Action is one of the projects authorized in Section 202 and 207. The cost sharing requirements associated with 202 and 207 would be met.

S.3.4 Preferred Alternative

In this EIS the Proposed Action is the same as the Preferred Alternative. The CUWCD Board of Directors adopted the WCWEP With Daniel Replacement Pipeline as the Proposed Action in May of 1995.

The term "Preferred Alternative" as used in an EIS is when the lead agencies preferred alternative is different than the Proposed Action of a permit application from a non-agency entity. This situation does not exist in this EIS since the lead agencies control the planning process as opposed to a permitting role.

S.4 Chapter 4 – Consultation and Coordination

The CUWCD conducted extensive consultation and coordination while preparing this EIS and performing related environmental and planning studies. Pre-scoping and scoping consultations were held with the public, agencies and organizations. Less formal consultations with agencies, organizations and technical experts took place throughout the environmental analysis and preparation of the EIS.

The EIS scoping process included consultations with 29 agencies and organizations as well as 260 members of the general public. The concerns voiced by people at district workshops were incorporated into the Preliminary Planning Report in February 1993. Additional comments received at scoping meetings in February of 1993 and in March of 1994, and others received in writing after the meetings were analyzed and used to finalize the alternatives and scope of the EIS. A Scoping Summary Report (CUWCD 1995) released in May 1995 identified the following resource topics as the most important to the public, agencies and organizations that participated in scoping: agriculture, surface water, socioeconomics, wildlife resources, aquatic resources, wetlands and recreation. Resource topics identified as moderately important included threatened and endangered species, water quality, groundwater and health and safety.

Additional consultation and coordination occurred during the preparation of the EIS, and early planning studies. The following committees provided valuable input and helped reach important decisions:

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- Provo/Wasatch Planning Coordination Committee (composed of 18 agencies and organizations)
- Wasatch County Water Efficiency Study Advisory Committee (composed of 14 agencies and organizations)
- Irrigation Water Delivery Requirements Technical Committee (composed of 6 agencies and organizations)
- Groundwater and Return Flow Technical Committee (composed of 9 agencies and organizations)
- Fishery Technical Committee (composed of 16 agencies and organizations)
- Instream Flow Work Group (composed of 8 agencies and organizations)
- Wetlands Technical Committee (composed of 19 agencies and organizations)
- Water Quality Technical Committee (composed of 9 agencies and organizations)

The district also worked with the agencies and organizations to incorporate results of related studies, including the NRCS Tri-Valley Watershed Management Plan and the U.S. Forest Service plan for abandoning and removing the DIC irrigation facilities.

Draft work plans prepared for each resource topic addressed in the EIS were reviewed by 11 agencies and organizations and their comments incorporated into final work plans distributed in July and August 1994.

Chapter 1 of the Preliminary Draft Environmental Impact Statement was distributed to 14 agencies and organizations in July 1995 for early review and comment so they and their representatives would better understand the Proposed Action and alternatives as they reviewed the EIS technical reports.

Preliminary Draft EIS technical reports were distributed to 11 agencies and organizations for comments, and meetings were held to receive verbal comments. These meetings were held in October, November and December 1995, and additional comments were received in writing after the meetings.

The Preliminary Draft EIS was distributed to cooperating agencies for review and comment on March 1, 1996. Written comments were received through March 27, 1996 and changes were incorporated as part of preparing the Draft Environmental Impact Statement (DEIS).

Future consultation and coordination will include soliciting and incorporating comments on the DEIS, and public hearings on the DEIS. The remainder of the EIS process will continue to emphasize close consultation and coordination with agencies, organizations and the public.

Wasatch County Water Efficiency Project and Daniel Replacement Project

Draft Environmental Impact Statement

Chapter 1
Description of the Proposed Action and Alternatives

Chapter 1
Description of the Proposed Action and Alternatives

1.1 Introduction

This chapter describes the Proposed Action and alternatives, including the No Action Alternative. It describes the purpose and need for the projects, interrelated and authorizing actions and alternatives considered but eliminated from detailed analysis.

The Proposed Action is the Wasatch County Water Efficiency Project With Daniel Replacement Pipeline (WCWEP With Daniel Replacement Pipeline), which would replace water currently diverted from the upper Strawberry River basin by Daniel Irrigation Company (DIC). The replacement water would come from water efficiency improvements associated with the Proposed Action and the Tri-Valley Watershed Plan. The replacement water would be diverted at the Timpanogos Diversion on the Provo River near Jordanelle Reservoir and conveyed through the Timpanogos Canal, new pumping stations and pipelines. DIC would no longer divert water from the upper Strawberry River basin. The Proposed Action would also include the following changes:

- The water supplies of some irrigation companies in Heber Valley would be pressurized, facilitating the conversion from flood irrigation to more efficient sprinkler irrigation by Heber Valley farmers
- Water flowing through small distribution canals would be conveyed by pipelines, thus improving the efficiency of the water conveyance system
- Conserved water would be used to supplement the flows of five Heber Valley streams: Rock Ditch, Spring Creek, lower Lake Creek, London Ditch and Creamery Ditch
- Pumping facilities would be provided to allow Heber City to purchase pressurized water for a secondary, outdoor irrigation system that would be installed by the city
- Diversion facilities in the upper Strawberry River basin would be removed after the DIC transbasin diversion is terminated. This action would include addressing environmental and public safety concerns.

The alternatives assessed in this Environmental Impact Statement (EIS) are the Daniel Replacement Project (DRP) With Pipeline Alternative, DRP With Canal Alternative and the No Action Alternative. (Note: The term "Daniel Replacement Project" — and its acronym DRP — is only used when referring to the DRP alternatives and not the Daniel replacement portion of the WCWEP.) The DRP With Pipeline and DRP With Canal alternatives, like the Proposed Action, would replace water currently diverted by DIC from the upper Strawberry River basin by diverting water from the Provo River near Jordanelle Reservoir. The DRP With Pipeline Alternative would convey the replacement water through a new pipeline, with no canal modifications. The DRP With Canal Alternative would convey replacement water through an enlarged and rehabilitated canal and a pipeline, similar to the Proposed Action. Unlike the Proposed Action, neither of the DRP alternatives would improve the efficiency of water use in Heber Valley or supplement the flows of Heber Valley streams. Under the DRP alternatives, the DIC would receive water from Central Utah Project (CUP) agricultural water stored in Jordanelle Reservoir. This supply would be required to offset the reduction in DIC's supply from terminating the transbasin diversion. The amount of CUP agricultural water available for contracting to other Heber Valley irrigation companies would be reduced by the amount transferred to DIC. The DRP alternatives include removal of diversion facilities in the upper Strawberry River basin after the DIC transbasin diversion is terminated and would address environmental and public safety concerns. The No Action Alternative would not implement any of the actions described under the Proposed Action and DRP alternatives.

1.2 Purpose and Need

This section describes the purpose and need for the Proposed Action and alternatives.

1.2.1 Need for the Proposed Action and Alternatives

The Proposed Action and alternatives would respond to the following needs:

- To restore the flows in the upper Strawberry River that have been diverted by the DIC
- To provide water and water conveyance facilities to the existing DIC water storage facilities

Restoration of natural flows in the Strawberry River area is the highest priority aquatic mitigation measure in the Aquatic Mitigation Plan for the Strawberry Aqueduct and Collection System (Fish and Wildlife Service Interagency Aquatic Biological Assessment Team 1988). This measure, identified as the Strawberry Exchange in the mitigation plan, would compensate for the loss of trout spawning habitat and stream fishing opportunities caused by inundation from the enlarged Strawberry Reservoir.

In Section 303(b)(3)(A) of the Central Utah Project Completion Act (CUPCA), Congress recognized the need to replace water currently diverted from the upper Strawberry River basin in order to restore natural flows in the Strawberry River and its tributaries: "The District (Central Utah Water Conservancy District or CUWCD) shall construct a Daniels Creek replacement pipeline from the Jordanelle Reservoir to the existing DIC water storage facilities for the purpose of providing a permanent replacement supply of water in an amount equal to the Strawberry River basin water . . . ". DIC has diverted water continuously from the upper Strawberry River basin since the 1870s. The CUWCD would require the assignment from DIC (by warranty deed) of all of the Strawberry River basin water rights being diverted to Heber Valley through the Daniels Creek drainage in exchange for delivering replacement water from the Provo River basin to DIC. The CUWCD would deed the Strawberry River basin water rights to the Utah Division of Wildlife Resources for management in accordance with the provisions of Section 330(b) of Public Law 102-575. From 1950 to 1989, DIC has diverted an average of about 2,900 acre-feet of water per year from the upper Strawberry River basin into the Daniels Creek drainage to supplement the water supply from Daniels Creek. It is expected that DIC would continue to divert from the Strawberry River basin at the same rate, which means the permanent replacement supply of water to DIC would average 2,900 acre-feet per year.

1.2.2 Purposes of the Proposed Action and DRP Alternatives

Following are the purposes of the Proposed Action and DRP alternatives:

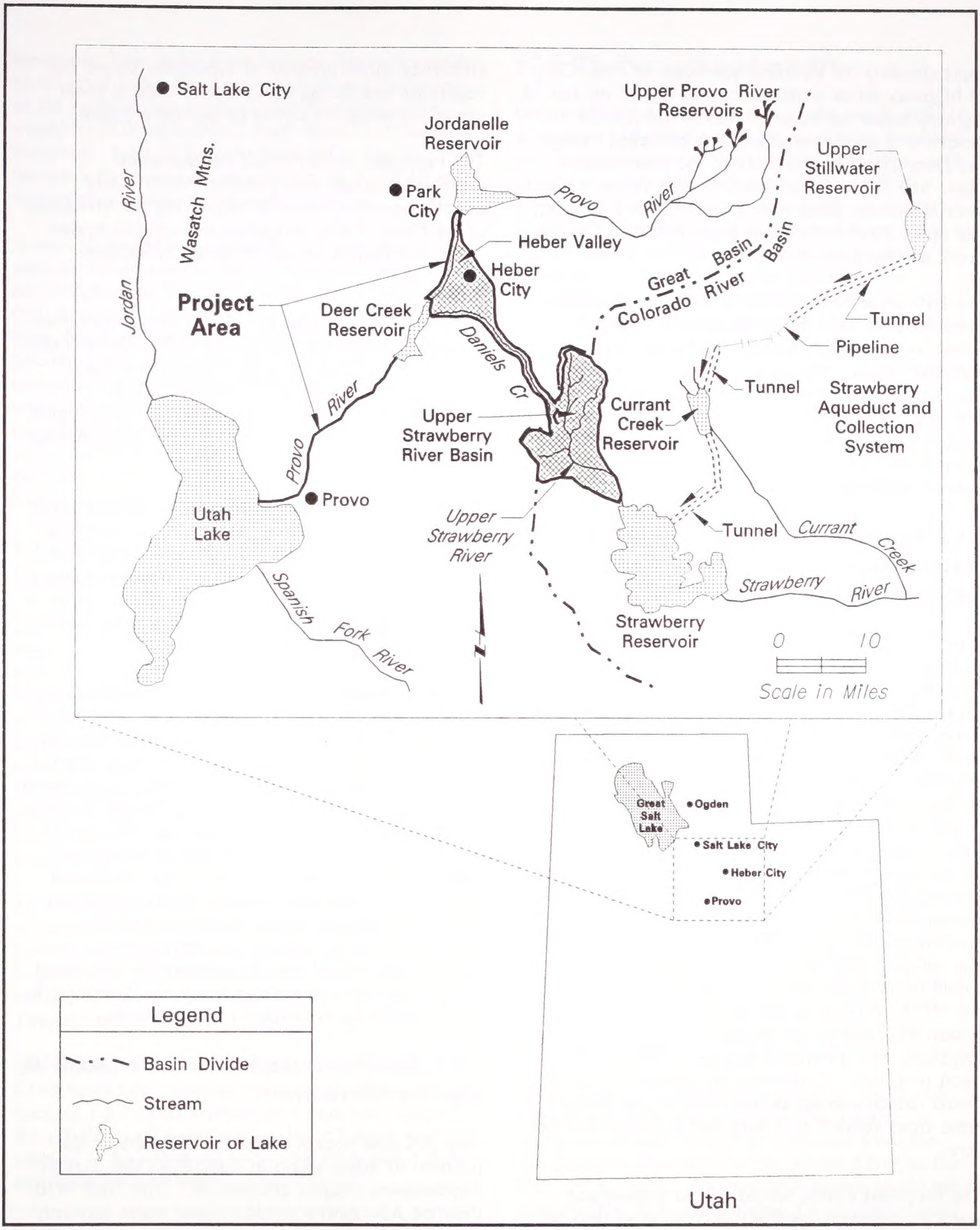
- To improve efficiencies, conserve water, and improve water management in Heber Valley by constructing water management facilities under Sections 202(a)(3) and 207 of CUPCA (see Section 1.4 of this chapter)
- To supplement flows in some Heber Valley streams through conservation and efficiency measures to improve environmental and recreation resources
- To protect the water rights of downstream users
- To minimize costs of project features
- To minimize adverse impacts on groundwater, wetlands and other environmental resources
- To return that portion of the Strawberry River and its tributaries affected by the DIC diversion facilities to a naturally functioning state

1.3 Overview of the Proposed Action and Alternatives

This section summarizes features of the Proposed Action and alternatives and highlights their major differences. Sections 1.8 through 1.12 describe the Proposed Action and alternatives in more detail.

1.3.1 Location of the Proposed Action and Alternatives

Map 1-1 shows the location of the Proposed Action and alternatives and the surrounding region. The features of the Proposed Action and alternatives would be located in Heber Valley and the upper Strawberry River basin. Heber Valley is on the eastern side of the Wasatch Mountains,



Map 1–1
Location of the Proposed Action and Alternatives

approximately 10 air miles southeast of Park City, 45 highway miles southeast of Salt Lake City and 30 highway miles northeast of Provo. Jordanelle Reservoir is on the northern edge of Heber Valley, and Deer Creek Reservoir is on the southwestern edge. The Provo River flows through Heber Valley from Jordanelle Reservoir to Deer Creek Reservoir. The upper Strawberry River basin is east of Daniels Creek and the basin divide.

The DIC diversion facilities in the upper Strawberry River basin (Map 1-1) are located on National Forest System land administered by the Uinta National Forest. They are used by DIC to divert, store and convey water to Daniels Creek on the west side of the basin divide. The Strawberry River flows southeast to Strawberry Reservoir. Daniels Creek flows northwest in Daniels Canyon, then west in Heber Valley to Deer Creek Reservoir.

1.3.2 The Proposed Action: Wasatch County Water Efficiency Project With Daniel Replacement Pipeline

Map A-1 (see pocket at back of EIS) shows the location of the major physical features of the Proposed Action. The Proposed Action would help improve water use efficiency in nine of the 12 Heber Valley irrigation companies, where pressurized water would allow farmers to convert from flood irrigation to sprinklers. Although not part of the Proposed Action, on-farm conversion to sprinkler irrigation systems would occur during construction, with funding provided under Public Law 83-566 (Watershed Protection and Flood Prevention Act). Financing would be administered by the Natural Resources Conservation Service (NRCS) as it implements the NRCS Tri-Valley Watershed Plan. The on-farm conversion to sprinkler irrigation would occur at the same time as implementation of the WCWEP because the WCWEP distribution system pipelines would be sized for sprinkler irrigation, which requires less flow capacity than flood irrigation. Conversion to sprinkler irrigation would reduce average annual water use in affected areas from about 5 to 7 acre-feet to 3 acre-feet per acre.

The Proposed Action would deliver pressurized water to irrigation company service areas through pipelines extending from the Timpanogos, Wasatch and Humbug canals. Pumps along these canals would pressurize water for nearly all land with water efficiency improvements at elevations above the Sagebrush and Spring Creek Canal. Land at lower elevations would be served by gravity pressure.

The Proposed Action would replace some distribution canals with pipeline, which would directly conserve water by improving the efficiency of the Heber Valley irrigation conveyance system. These distribution canals are listed in Section 1.8.2.1.4.

Water conserved under the Proposed Action would be used to supplement the flows of five Heber Valley streams: Rock Ditch, Spring Creek, lower Lake Creek, London Ditch and Creamery Ditch.
Map A-1 (see map pocket at back of EIS) highlights the stream reaches that would receive supplemental flows.

The Proposed Action includes energy and pumping facilities that would allow Heber City to pressurize water for lawn and garden irrigation under a local development known as the Heber City Secondary System (Section 3.1.2). The city would construct a buried pipeline system to replace small, dirt ditches now used to convey irrigation water.

Under the Proposed Action and DRP alternatives, natural stream flows in the upper Strawberry River basin and its tributaries would be restored after the transbasin diversion to Daniels Creek is terminated. Removal of the DIC diversion facilities in the upper Strawberry River basin after the transbasin diversion is terminated (as described in Section 1.8.7) would improve environmental conditions and minimize public safety hazards. This part of the Proposed Action would include stabilizing two headcuts and modifying existing canals, diversion facilities, reservoirs, a tunnel and siphon, stream gauges and roads. It also would include construction of a small buried pipeline within the existing canal network to deliver water to livestock watering troughs.

1.3.3 The Daniel Replacement Project With Pipeline Alternative

Map A-2 (see pocket at back of EIS) shows the location of major physical features of the Daniel Replacement Project alternatives. The DRP With Pipeline Alternative would replace water currently diverted from the upper Strawberry River basin by DIC that would be diverted at the Timpanogos Diversion on the Provo River near Jordanelle

Reservoir. This is the same location where it would be diverted under the Proposed Action. The source of the replacement supply under this alternative would be CUP agricultural water stored in Jordanelle Reservoir. Less CUP agricultural water would therefore be available for contracting to other irrigation companies than under baseline.

A new 11.9-mile long pipeline with pumping stations would convey the replacement water from the Timpanogos Diversion to the DIC service area. DIC diversion facilities in the upper Strawberry River basin also would be removed as summarized in Section 1.8.7. Unlike the Proposed Action, this alternative would not improve the efficiency of water use by Heber Valley's irrigation companies or supplement flows of the five streams to be enhanced under the Proposed Action. None of the irrigation facilities of the other irrigation companies in the Valley would be modified.

1.3.4 The Daniel Replacement Project With Canal Alternative

The DRP With Canal Alternative would replace water currently diverted from the upper Strawberry River basin by DIC with CUP agricultural water from Jordanelle Reservoir. Map A-2 (see pocket at back of EIS), shows that replacement water would be diverted at the Timpanogos Diversion and conveyed to the DIC service area through an enlarged Timpanogos Canal, new pumping stations and pipelines. Water currently conveyed by the Timpanogos Canal would continue to be conveyed and delivered by the enlarged Timpanogos Canal.

The Timpanogos Canal would not carry replacement water and would not be enlarged between the Provo River and the crossing of Highway 32. Replacement water would be conveyed through a bypass pipeline in this reach from the Timpanogos Diversion to the Highway 32 crossing.

DIC diversion facilities in the upper Strawberry River basin also would be removed as summarized in Section 1.8.7. This alternative would not improve the efficiency of water use in Heber Valley, and the streams to be enhanced under the Proposed Action would not receive supplemental flows.

1.3.5 The No Action Alternative

Under the No Action Alternative the needs defined in Section 1.2 would not be met and there would be no change in water efficiency, instream flows, and canal capacities and operations in Heber Valley. There also would be no change in the operation of diversions from the upper Strawberry River basin to Daniels Creek, and baseline conditions would continue. Section 1.11 further describes the commitments included in the EISs related to Jordanelle Reservoir that would be would occur under baseline conditions (USBR [U.S. Bureau of Reclamation] 1979 and USBR 1987). The impacts caused by these commitments implemented under baseline conditions and would continue under the No Action Alternative.

1.3.6 Major Differences Between the Proposed Action and Alternatives

Table 1-1 presents a Proposed Action and alternatives definition matrix, which identifies the features of the Proposed Action and alternatives. Table 1-2 summarizes the key characteristics of the Proposed Action and alternatives. One primary difference between the Proposed Action and the two DRP alternatives is the Proposed Action would facilitate Heber Valley farmers converting to sprinkler irrigation and Heber City developing the Heber City Secondary System. Another primary difference is that the Proposed Action would enhance Heber Valley streams with supplemental flows.

To provide pressurized water and supplemental flows, the Proposed Action would modify more conveyance facilities than the DRP With Canal Alternative. The DRP With Canal Alternative would modify only the Timpanogos Canal, while the Proposed Action would modify the Timpanogos, Wasatch and Humbug canals. The DRP With Pipeline Alternative would not modify any canals.

Another major difference between the Proposed Action and DRP alternatives is how Daniel replacement water would be conveyed from the Timpanogos Diversion on the Provo River to the DIC service area. The Proposed Action would use a combination of a rehabilitated Timpanogos Canal and a new 5-mile-long pipeline to convey the Daniel replacement water. The DRP With Pipeline Alternative would convey replacement water

Table 1-1
Proposed Action and Alternatives Definition Matrix

Features	Proposed Action (WCWEP with Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative	No Action Alternative
Daniel Replacement Water Sources: Conserved Water	yes	no	no	no
Daniel Replacement Water Sources: CUP Agricultural Water	no	yes	yes	no
Daniel Replacement Water Conveyed w/Canal	yes	no	yes	no
Daniel Replacement Water Conveyed w/Pipeline	yes*	yes*	yes*	no
Facilitates Conversion From Flood to Sprinkler Irrigation	yes	no	no	no
Streams Enhanced with Supplemental Flows	yes	no	no	no
Timpanogos Canal Used for Conveyance w/No Enlargement	yes	no	no	no
Timpanogos Canal Used for Conveyance and Enlarged	no	no	yes	no
Wasatch/Humbug Canal Used for Conveyance	yes	no	no	no

Notes:

*The Proposed Action and Daniel Replacement Project With Canal Alternative would convey Daniel Replacement water with 5 miles of new pipeline while the Daniel Replacement Project With Pipeline Alternative would have 11.9 miles of new pipeline.

Table 1-2
Key Characteristics of Proposed Action and Alternatives*

	Proposed Action (WCWEP With Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Area Converted from Flood to Sprinkler Irrigation (acres)	3,675	0	0
Length of New Pipeline, Heber Valley (miles)	42.4	11.9	5.3
Length of New Pipeline, Strawberry Valley (miles)	3	3	3
Length of Existing Canals Rehabilitated (miles)	16.3	0	12.0
Length of Canal Enlarged (miles)	0	0	9.3
New Pumping Stations (number)	10	3	3
Energy Use (kwhr/yr)	3,005,000	832,000	802,000
Existing Sprinkler System Booster Pumps Discontinued (number)	32	0	0
Length of Streams Enhanced, Heber Valley (miles)	9.2	0	0
Length of Streams Enhanced, Strawberry Valley	34.5	34.5	34.5
Power Line Extensions (miles)	3.6	0.7	1
Length of O&M Roads (miles)	1	0	2.8

Notes:
*All values would be zero under the No Action Alternative.

through a new 11.9-mile-long pipeline, which is different than the Daniel replacement portion of the Proposed Action. The DRP With Canal Alternative would convey replacement water through a rehabilitated and enlarged Timpanogos Canal and a new 5-mile-long pipeline. It is the only alternative that would enlarge the capacity of an existing canal (i.e., the Timpanogos Canal). Table 1-2 shows that the Proposed Action would use more than three times the energy of either DRP alternative.

1.4 History and Background

1.4.1 Statutory Background

The statutory foundation of the WCWEP and DRP is found in CUPCA (Public Law 102-575). Section 202(a)(3) of CUPCA instructs the CUWCD to conduct a feasibility study, with public involvement, on efficiency improvements in the management, delivery and treatment of water in Wasatch County without interfering with downstream water rights. The study must identify procedures that, if implemented, would increase efficient use of water in Wasatch County.

Section 303(a)(3)(A) of CUPCA instructs the CUWCD " . . . to construct a pipeline from the Jordanelle Reservoir to the DIC water storage facilities for the purpose of providing a permanent replacement supply of water in an amount equal to the Strawberry River basin water being supplied by the District for stream flows which would otherwise have been diverted to the Daniels Creek drainage." Subsection D of the same section further instructs that " . . . funds provided for the Daniel Replacement Pipeline may be expended so as to integrate such pipeline with the Wasatch County conservation measures provided for in Section 207(e)(2) and the Wasatch County Water Efficiency Project authorized in Section 202(a)(3)."

Section 207 of CUPCA authorizes a comprehensive program to study and improve water management within the CUWCD service area. It defines water conservation measures as actions taken to improve the efficiency of water storage, conveyance, distribution, or use, exclusive of dams, reservoirs or wells. Section 207(e)(2) authorizes $50,000,000 in federal funds to help finance the cost of CUWCD implementing water conservation measures. Ten million of the $50 million dollars is designated for conservation measures in Wasatch County.

CUPCA authorized funds to study WCWEP and DRP and designated the CUWCD to function as a federal agency to comply with the National Environmental Policy Act (NEPA) and authorized CUWCD to perform other project-related tasks, such as managing, planning, design and construction. CUPCA also established the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission), which is responsible for funding the DRP, funding and implementing mitigation measures included in the Proposed Action and DRP alternatives, and other fish and wildlife mitigation projects authorized by CUPCA. The Mitigation Commission is not responsible to fund mitigation required under Section 207.

1.4.2 Project Approach and History

The Proposed Action and alternatives assessed in this EIS are the result of studies performed by the CUWCD. The Wasatch County Water Efficiency Study Preliminary Planning Report, completed by CUWCD in February 1993, identified and described many opportunities for designing and implementing water efficiency improvements in Heber Valley and replacing water diverted by DIC from the upper Strawberry River basin (CUWCD 1993a). The report determined the benefits to the region would be maximized if improved water efficiency and replacement of DIC water supply were planned and operated in conjunction, given their close water supply relationship and geographic proximity. For example, water efficiency improvements would reduce the demand for water in Heber Valley, making conserved water available to be conveyed to DIC via Daniel replacement facilities. The water delivered to DIC, other Heber Valley irrigation companies and the enhanced streams could be conveyed and pumped by common facilities. The coordinated and integrated design and operation of these improvements would minimize the number of new facilities, thus minimizing environmental impacts and construction costs. For these reasons, the Preliminary Planning Report concluded the Proposed Action should integrate facilities that would convey Daniel replacement water.

The interrelationships between surface water and groundwater hydrology in Heber Valley have played a key role in the design of the Proposed Action and

DRP alternatives. Historically, irrigation water from the Provo River has been diverted in Heber Valley under water rights that are junior to those of users downstream of Deer Creek Reservoir. These diversions have been allowed because water applied via flood irrigation in Heber Valley during relatively high flow months returns to the Provo River and improves the yield of senior downstream water rights during later months when flows are usually lower. The Proposed Action and DRP alternatives have been designed to avoid reducing Provo River water supplies to senior downstream users. This is done by only storing conserved water when it will not decrease the quantity of water that would have been diverted by lower Provo water users if the irrigation efficiency improvements were not implemented. If the operation of the Proposed Action or a DRP alternative in a previous month decreases the water supply of a downstream user, water would be released from CUWCD storage to supplement that user. Jordanelle and Deer Creek reservoirs would be operated in accordance with the November 1, 1994 Jordanelle-Deer Creek Operating Agreement and to avoid impacts on downstream users.

As noted in Section 1.4.1, CUPCA instructed CUWCD to construct a Daniel replacement pipeline. The DRP alternatives were formulated to determine the feasibility and impacts of providing DIC with a replacement supply without the water efficiency improvements and supplemental stream flows included in the Proposed Action. The option of conveying the replacement supply in the Timpanogos Canal, as opposed to conveying the replacement supply entirely by pipeline, was identified by CUWCD and carried forward as the DRP With Canal Alternative.

The Preliminary Planning Report study and subsequent studies considered additional alternatives to those addressed by this EIS. Section 1.13 describes the other alternatives and summarizes reasons why they were eliminated from detailed analysis in this EIS.

1.5 Authorizing Actions, Permits and Licenses

This section defines the actions, permits and contracts needed to construct and operate the Proposed Action and alternatives. Table 1-3 defines authorizing actions of individual agencies and includes information concerning the types of actions, agencies responsible for each action and related project features. Table 1-4 defines contracts or agreements that would involve multiple parties and would be needed to construct and operate the Proposed Action and alternatives. Local entities would negotiate agreements and contracts required to acquire water rights, facilities and rights-of-way necessary to construct and operate the project. Eminent domain could be exercised if negotiations are not successful.

1.6 Provo River System Operational Changes

Additional features that were included or assumed as part of the analysis of the Proposed Action and the Daniel Replacement Alternatives include the following:

- Water right change applications
- River operational procedures to mitigate the effects of the WCWEP
- CUP reservoir operational procedures associated with the pre-release of conserved water.

Each of these features is briefly described below.

1.6.1 Water Right Change Applications

The basic premise of the WCWEP is that irrigation efficiency improvements instituted as part of the project would conserve direct-flow diversions, which could then be stored in Jordanelle Reservoir. These conserved diversions would be released later to provide a supply of water to replace discontinued transbasin diversions to DIC, to supplement the flow of Heber Valley streams, and to mitigate the effects of changes in Heber Valley return flows on downstream water users. Storage of the conserved direct-flow rights and the release and delivery of this water would require filing and approval of water right change applications with the State Engineer, as well as agreements between CUWCD, The U.S. Department of the Interior and downstream water users.

Individual irrigation companies holding direct-flow water rights would file change applications that would call for storage of the water in Jordanelle

Table 1-3
WCWEP and DRP Authorizing Actions

Page 1 of 2

Agency	**Authorizing Action**	**Description and Project Feature**
FEDERAL AGENCIES		
CUWCD (The CUWCD is acting as a federal agency for purposes of completing this EIS)	Approval of Proposed Action, EIS and Record of Decision (ROD)	The CUWCD is serving as lead agency on this EIS and would be responsible for implementing the Proposed Action.
Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission)	Approval of Proposed Action, EIS and ROD	The Mitigation Commission is serving as a joint-lead agency on this EIS, would be responsible for funding the Daniel Replacement Project, and is implementing the mitigation measures authorized by CUPCA.
Department of the Interior (DOI)	Approval of Proposed Action, EIS and ROD	DOI is serving as a joint-lead agency on this EIS and oversees the implementation of CUPCA.
U.S. Forest Service (USFS)	Revocation of existing Special Use Permit for Daniel Irrigation Company transbasin diversion	Daniel Irrigation Company has a Special Use Permit for its diversions from the upper Strawberry River basin to Daniels Creek. The USFS would need to revoke this permit after the Proposed Action has been approved.
U.S. Fish and Wildlife Service (FWS)	Ensures Endangered Species Act compliance	FWS review and consultation is required to protect candidate, threatened and endangered species. FWS will issue a Biological Opinion after it reviews the project's Biological Assessment.
U.S. Fish and Wildlife Service (FWS)	Ensures compliance with the Fish and Wildlife Coordination Act (FWCA)	FWS will prepare a FWCA Report which evaluates project impacts on fish and wildlife resources and provides mitigation recommendations to CUWCD.
U.S. Army Corps of Engineers (COE)	Approves application for permit under Section 404 of the Clean Water Act	A Section 404 permit would be needed from the COE because the construction of the Proposed Action and alternatives would include placement of fill material into "waters of the U.S.", including wetlands.
U.S. Environmental Protection Agency (EPA)	Has veto authority on Section 404 permits issued by COE and 401 permits issued by state water quality agency (see below); also reviews and rates adequacy of all EISs	If the EPA feels potential wetlands, water quality or other impacts have not been sufficiently avoided or mitigated, it can suggest additional mitigation, new alternatives or prevent the issuance of a permit.
U.S. Bureau of Reclamation (USBR)	Issues land-use easement or license	A land-use easement or license would be required for those USBR lands crossed by the DRP pipeline (south of and near Jordanelle Reservoir).

Table 1-3
WCWEP and DRP Authorizing Actions

Page 2 of 2

Agency	Authorizing Action	Description and Project Feature
STATE AGENCIES		
Utah Department of Natural Resources (UDNR), Division of Water Rights, State Engineer	Approves changes in water rights, diversions and places of water use; issues permits for modifying stream channels; transfer of Daniel Irrigation Company's Strawberry basin water right to DOI	Approval of the project's new diversions, places of use, and nature of use would be required. If modifications to stream channels are made during project construction, a permit Utah State law (73-3-29, Utah Code Annotated) also would be required.
Utah Department of Environmental Quality (UDEQ), Division of Water Quality	Issues Section 401 water quality certifications and Section 402 permits for construction	A Section 401 water quality certification under the Clean Water Act would be issued once this agency determined the project's water quality impacts were sufficiently mitigated; required for Section 404 permits.
Utah Department of Transportation (UDOT)	Issues permits for crossing highway right-of-ways	A permit would be required for the crossing of state Highways 40 and 32 by the DRP pipeline and Highways 189, 113 and River Road by WCWEP pipelines.
LOCAL AGENCIES		
Wasatch County Transportation Department	Issues permits for crossing county roads	The DRP pipeline and WCWEP pipelines would cross county roads.
Wasatch County Planning Department	Issues building permits	Permanent building permits would be needed for all permanent structures (pumping stations and power line poles), and temporary permits would be needed for temporary structures used during construction.

Table 1-4
WCWEP and DRP Contracts and Agreements

Page 1 of 2

Contract or Agreement	Agencies That Would Enter Into or Approve Contract or Agreement	Description
Cultural Resources Programmatic Agreement	Utah State Historic Preservation Office (SHPO), CUWCD and DOI	This agreement would be required under the National Historic Preservation Act to minimize and avoid adverse impacts to cultural resources under the Proposed Action and alternatives; would guide future cultural resource studies and mitigation.
Daniel Replacement Water Contract	Daniel Irrigation Company (DIC), and CUWCD	This agreement would define the terms and conditions by which replacement water is delivered to DIC once the transbasin diversion is terminated under the Proposed Action and alternatives and water rights assigned.
Operation, Maintenance and Replacement Agreement	Wasatch County Special Service Area (WCSSA), CUWCD and the Mitigation Commission	Would include the terms and conditions for CUWCD delivering water to Heber Valley diversion points and WCSSA subsequently conveying and delivering water to Valley irrigation companies; cost allocation and replacement terms and conditions would be included and would be required for Proposed Action and alternatives
Contract for CUP Agricultural Water	WCSSA and CUWCD, approved by DOI	Would provide supplemental irrigation water from the CUP to water users in Heber Valley after Proposed Action or alternatives are implemented
Contract for CUP M&I Water	WCSSA, CUWCD and DOI	Would provide M&I water from CUP to water users in Heber Valley after Proposed Action or alternatives are implemented
D&MC Contract	CUWCD, Mitigation Commission and DOI	Would provide funding from DOI for construction of Proposed Action and alternatives and would identify responsibilities of each party
Section 207 Cooperative Agreement	DOI and CUWCD	Would provide funding for Section 207 facilities included in the Proposed Action
Section 207 Third Party Funding Agreement	WCSSA and CUWCD	Would provide funding for Section 207 facilities included in the Proposed Action to a third party (WCSSA)
Carriage Contracts	Various irrigation companies, WCSSA and CUWCD	Would provide for conveyance of non-CUP water through Proposed Action and alternatives facilities
Agreements Between WCSSA and Irrigation Companies	WCSSA and various irrigation companies	Would allow WCSSA to use and operate facilities belonging to irrigation companies to convey supplemental stream flows to five Heber Valley streams under the Proposed Action

Table 1-4
WCWEP and DRP Contracts and Agreements

Page 2 of 2

Contract or Agreement	Agencies That Would Enter Into or Approve Contract or Agreement	Description
Agreement Between WCSSA and North Fields Irrigation Co.	WCSSA and North Fields Irrigation Co.	Would provide for modifying flows through North Fields ditches under the Proposed Action
Agreement Between WCSSA and Sagebrush and Spring Creek Canal Co.	WCSSA and Sagebrush and Spring Creek Canal Co.	Would provide for the conveyance of supplemental flows to Lake Creek under the Proposed Action and through the Sagebrush and Spring Creek Canal
Contract for Purchase of Canal Facilities	WCSSA and DOI; and WCSSA and Mitigation Commission	Would provide for transfer of ownership of canal facilities from WCSSA to the federal government under the Proposed Action and alternatives
Warranty Deeds	WCSSA and various land owners	Would provide for transfer of ownership of required parcels of land from various land owners to WCSSA to construct, operate and maintain Proposed Action and alternatives facilities
Easements	Various land owners, USBR, WCSSA or CUWCD	Would grant rights for temporary or permanent easements from land owners to WCSSA or CUWCD to construct, operate and maintain Proposed Action and alternatives facilities
Master Contract	CUWCD, DOI, Mitigation Commission, and WCSSA	Would define general responsibilities among these agencies during the planning, final design, construction and implementation of the WCWEP and DRP
Section 303 Cooperative Agreement	CUWCD, Mitigation Commission and DOI	Provide funding for Section 303 facilities integrated into the Proposed Action and assignments of DIC water rights

Reservoir at the same priority associated with their direct-flow right. These applications also would need to specify a change in place of use to include DIC, Heber Valley streams and the North Fields area. The change applications would go through the State Engineer's review and comment procedures.

1.6.2 River Operational Procedures

River-flow accounting procedures would need to be developed and implemented under the WCWEP to quantify and correct the effects on direct-flow water users downstream of Heber Valley. These procedures would be used to estimate the volume of direct-flow water that would have been available to Provo Division water right holders if irrigators in Heber Valley would have applied their full direct-flow rights, rather than the quantity under the WCWEP. Releases of water from Jordanelle Reservoir would be made when inflows to Deer Creek Reservoir would otherwise be less than baseline inflow and would have been beneficially used by downstream users. Conversely, increased inflow would be computed and credited to the CUP system storage account during periods of greater inflow to Deer Creek Reservoir than what would have occurred under baseline.

These procedures could make use of PROSIM's (Provo River Simulation Model) flow calculation routines to estimate monthly changes in inflow to Deer Creek Reservoir resulting from the project. These effects could then be accumulated to estimate their affect on downstream diversions. If the procedures indicated an adverse impact on downstream water users, the River Commissioner could request release of water from conserved water stored in Jordanelle Reservoir to mitigate the impact. These river operational procedures would presumably be developed and implemented as part of the water right change applications described above.

1.6.3 CUP Reservoir Operational Procedures

Because there is a finite amount of storage capacity available in Jordanelle Reservoir, during certain water years, Jordanelle Reservoir would be full when conserved water would be available for storage. This inability to store conserved water would not eliminate the need to release water to replace DIC's transbasin supply or to mitigate project impacts. Under these conditions, conserved water would be "pre-released," meaning that CUP water stored in Jordanelle Reservoir would be released when conserved water is unavailable. The released CUP water would subsequently be replaced by water conserved during the following spring. Even if the following year is dry, approximately 15,000 acre-feet of water would be conserved and used to refill borrowed storage in Jordanelle Reservoir.

This pre-release of conserved water in one year from the amount to be conserved in the following year would result in slightly greater drawdown of Jordanelle Reservoir. During years when Jordanelle Reservoir approaches the minimum conservation pool, the borrowed storage would be refilled by reducing supplemental flows to local streams and, if necessary, reducing CUP agricultural water deliveries in Heber Valley. In the simulation modeling performed for this EIS, the pre-release did not result in impacts to CUP deliveries. However, it is expected that agricultural users and the supplemental stream flows in Heber Valley may experience shortages under more adverse hydrological periods than those modeled. This would be justified because these are the water users that would benefit from the Proposed Action.

1.7 Interrelated Projects

This section describes projects that could cause cumulative impacts with the Proposed Action (WCWEP With DRP Pipeline) and DRP alternatives. These projects are referred to as interrelated projects.

The Council on Environmental Quality (CEQ) Regulations (CEQ 1978) provide broad guidelines on what is to be considered in a cumulative impact analysis. Section 1508.7 of the regulations define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Cumulative impacts are impacts caused by two or more projects on the same resource. Certain past projects have caused impacts in the impact area of influence and are part of the baseline conditions against which the impacts of the Proposed Action and DRP alternatives are measured.

The interrelated projects defined in this section have impacted or are expected to impact the same resources that would be impacted by the Proposed Action and DRP alternatives. Interrelated projects from the past have influenced the affected environment (baseline conditions) defined for each resource topic in Chapter 3.

As noted in the paragraph above, only "reasonably foreseeable" projects need to be included in the consideration of cumulative impacts. "Reasonably foreseeable" in this EIS means the project or action is identified and described in an approved public document such as a state, county or federal agency plan. There also is some expectation that the project or action would be funded. These potential projects and actions are expected to occur during construction or operation of the Proposed Action or DRP alternatives. A proposal or project must be described in sufficient detail to allow a determination of its potential impacts. Further, the determination of cumulative impacts is based on net impacts, or those impacts remaining after mitigation has been applied.

The first step in determining the future interrelated projects to consider in the WCWEP and DRP cumulative impact analysis was to develop a list of potential projects and actions. To accomplish this task the following entities were contacted: the Natural Resources Conservation Service (NRCS), Utah Department of Transportation (UDOT), Wasatch County Planning Department and Wasatch County Special Service Area (WCSSA). The identified projects and actions were then compared against the criteria described in the paragraph above to determine if they should be included in the cumulative impact analysis.

Section 1.7.1 describes past and future interrelated projects that were addressed in the cumulative impacts analysis, while Section 1.7.2 defines potential projects that were not addressed in the cumulative impact analysis. The results of the cumulative impact analysis are presented in Section 3.21 of this EIS.

1.7.1 Projects Addressed by the Cumulative Impact Analysis

1.7.1.1 Past Interrelated Projects

1.7.1.1.1 Agricultural and Urban Development in Heber Valley. Most of Heber Valley has been developed for agricultural purposes and has recently experienced a housing construction boom. Heber Valley was settled by farmers during the 1860s and their diversions from the Provo River and other streams were used to irrigate pasture land and grow such crops as alfalfa and small grains. Today, approximately 12,800 acres in Heber Valley are irrigated for agricultural purposes, and additional lands in the Valley and surrounding uplands are used for grazing. While agricultural lands benefit some wildlife, most native species have been adversely impacted by the conversion of riparian woodlands and other habitat types to agricultural and urban land uses.

The amount of land developed for urban land uses (especially residential uses) has increased dramatically in Heber Valley in recent years. Since 1985 through May 1996, about 47 subdivision projects have been constructed in Heber Valley (Wasatch County Planning Department 1996). Most of this construction has occurred during the 1990s. Approximately 830 single-family and 250 multi-family lots have been constructed in Midway, Charleston, Daniels, Heber City and the Lake Creek/Center Creek area east of Heber City. These projects have been built on about 1,000 acres, not including the Midway subdivisions. According to data from the Bureau of Economic and Business Research at the University of Utah, 249 permits for new single-family dwelling units were issued in 1994, compared to an average of 60 per year from 1980 to 1989 and an average of 128 per year from 1990 to 1994 (Bureau of Economic and Business Research, 1990, 1993, and 1995).

Agricultural and urban development in Heber Valley has impacted some of the same resources that would be affected by the Proposed Action and DRP alternatives. The primary EIS resource topics related to these cumulative impacts are water resources, wetlands, aquatic resources, water quality, threatened and endangered species, agriculture, socioeconomics and wildlife resources.

1.7.1.1.2 Modifications to the Provo River in Heber Valley. Past modifications to the Provo River in Heber Valley have had a significant impact on the Valley's water resources, aquatic resources, wetlands and wildlife habitat. Historical photographs of the Provo River in Heber Valley show a broad area of dense riparian vegetation 1,000 feet wide or more. The Provo River also was more sinuous as is typical of naturally functioning rivers. Over the past 100 years or so, the following types of modifications have been made to the River:

- Construction of dikes along most of the River in Heber Valley to control flooding and channel migration
- Construction of hard sills or dams at points of irrigation diversions
- Diversion of River flows to satisfy agricultural water supplies
- Construction of transbasin diversions from to the Provo River watershed from the Weber, Duschene and Strawberry River basins
- Clearing and filling of abandoned floodplain areas to support agricultural land uses along the River
- Construction and filling of Jordanelle Dam and Deer Creek Reservoir

These modifications and other important human-induced changes to the Provo River corridor in Heber Valley are summarized in the PRRP Technical Report (CUWCD 1994a). Heber Valley was an important spawning area for native cutthroat trout from Utah Lake. However, the native cutthroat populations in Heber Valley were largely eliminated by dewatering of the River by irrigation and power diversions that started in the 1930s and completion of Deer Creek Reservoir in 1941. However, the stocking of non-native trout allowed the River's fishery in Heber Valley to still be one of the best in the state until the 1950s when USBR flood control projects greatly altered the River channel. These projects, including construction of dikes and filling of abandoned floodplain areas, were designed to provide a safe and larger channel capacity that could handle high spring runoff flows from the Provo River basin plus additional flow of up to 1,000 cfs from the Duschene and Weber river transbasin diversions. River channel modifications have occurred every year since the 1950s as the Provo River Water Users rework cobble in the channel at diversions and along dikes. Construction of Jordanelle Dam began in 1990 and the filling of Jordanelle Reservoir began in 1993.

The primary EIS resource topics related to the impacts of past Provo River modifications are water resources, wetlands, aquatic resources, water quality, threatened and endangered species, agriculture, socioeconomics and wildlife resources.

1.7.1.2 Future Interrelated Projects

This section summarizes future projects that are reasonably foreseeable and could cause cumulative impacts under the Proposed Action and DRP alternatives. The following subsections summarize the schedules of these projects and identify the primary EIS resource topics that are related to the projects.

1.7.1.2.1 Urban Development in Heber Valley. The recent trend of increasing urban development in Heber Valley is expected to continue. The driving forces of growth in Heber Valley — population and employment growth along the Wasatch Front and in Summit County — are not expected to subside in the foreseeable future. Heber Valley will continue to be an attractive "bedroom community" for people who need to be within commuting distance of some of Utah's major employment centers while living in a rural and scenic area.

As of May 1996, about 28 residential subdivisions have been or are expected to be approved for construction in Heber Valley. These projects would be constructed on approximately 2,100 acres (not including projects in Midway) and would have about 1,530 single-family lots and 321 multi-family units. These housing developments will mostly be in the vicinity of Midway, Charleston, Daniels, Heber City and the Lake Creek/Center Creek area east of Heber City. County planning officials foresee as many as 5,800 new single-family dwelling units built in Wasatch County in the next 20 years, an average of 290 per year (Noffsinger 1995). An additional 13 developments with about 2,787 single-family lots, 2,799 multi-family units and 1,300 hotel/motel rooms have been proposed near Jordanelle Reservoir. Heber Valley's permanent population and traffic will increase significantly after these projects are completed. For example, Heber City's population is expected to increase from about 5,000 people today to 8,000 by the year 2015 (Heber City 1996). The Wasatch County Planning Department expects the County's population to increase from about 12,200 to 28,400, or 133 percent, over the next 20 years (Wasatch County Planning Department 1996).

Future urban development in Heber Valley will impact some of the same resources that would be affected by the Proposed Action and DRP alternatives. The primary EIS resource topics related to these future cumulative impacts are water resources, wetlands, aquatic resources, water quality, threatened and endangered species, agriculture, socioeconomics and wildlife resources.

1.7.1.2.2 The Provo River Restoration Project. The PRRP is described in Chapter 1 of the PRRP EIS and would modify and restore the existing Provo River channel between Jordanelle and Deer Creek reservoirs. The PRRP would cause construction-related impacts under the Proposed Action and DRP alternatives because Reaches 7, 8 and 9 of the PRRP Proposed Action (Riverine Habitat Restoration) and Existing Channel Modification Alternative would be constructed at the same time as the Proposed Action and DRP alternatives. All of the PRRP Instream Structures Alternative would be constructed at the same time as the WCWEP Proposed Action and DRP alternatives.

The Proposed Action, DRP alternatives and PRRP also would cause cumulative impacts on certain resources after they are constructed. The PRRP would improve the habitat of aquatic species and T&E species, riparian vegetation and recreation opportunities along the river. Wetlands, adjacent farm land, local residents and land owners would be impacted by the PRRP. A peak of approximately 15 workers would construct the PRRP at any one time. The primary EIS resource topics related to this project would be wetlands, aquatic resources, wildlife resources, threatened and endangered species, socioeconomics and recreation.

1.7.1.2.3 The Tri–Valley Watershed Plan. The NRCS is developing a watershed plan for Heber Valley, Round Valley and the southern portion of Kamas Valley. New water quality management techniques and sprinkler irrigation conversions would be cost–shared by the NRCS and implemented on a voluntary basis by eligible local farmers and ranchers. The plan is scheduled for completion during 1996, and the sprinkler irrigation conversions are expected to occur concurrently with construction of the Proposed Action and with Public Law 566 funding. Unlike the Proposed Action, the DRP alternatives and No Action Alternative would not provide pressurized water to Heber Valley irrigation companies and farmers. Therefore, the on-farm conversions to sprinkler systems that are described in Section 3.1.2.1 of this EIS would not occur without the Proposed Action. The water quality management elements of the plan, which would be voluntary and take longer to implement, would focus on education and demonstration projects during the first two years of implementation. Participation in voluntary portions of the plan would probably increase during subsequent years, but the final level of participation is unknown.

The water quality elements of the plan would be designed to control erosion and pollutants from dairies, feedlots, and surface return flows. Practices may include fencing, filter strips, land-use changes from pasture to cropland, streambank stabilization, improved animal-waste management and utilization, constructed wetlands and a prescribed grazing system. During the long–term, the plan is expected to improve water quality in Heber Valley streams and Deer Creek reservoirs by reducing sedimentation and phosphorous and nitrogen runoff from pastures, croplands and confined feeding operations. The primary EIS resource topics related to this project would be water quality, aquatic resources, agriculture and socioeconomics.

1.7.1.2.4 Highway 40 Upgrade North of Heber City. UDOT plans to widen State Highway 40 in Heber Valley from the River Road intersection to the northern boundary of Heber City, doubling capacity from two to four lanes when completed in the fall of 1997. UDOT projects a peak of 66 construction workers. Impacts would include physical disturbance of wetlands and other resources in the highway right–of–way, socioeconomic impacts from construction workers and air quality, noise and traffic impacts. The affected EIS resource topics would be wetlands, aquatic resources, socioeconomics, air quality, noise and transportation.

1.7.1.2.5 Expansion of the Regional Wastewater Treatment Plant in Heber Valley. The Heber Valley Special Service District and the Utah Division of Water Quality are planning to expand the capacity of the existing regional wastewater treatment plant in Heber Valley. The expansion, expected to occur in the next five to seven years, is needed to handle the significant increase in wastewater to be generated by new development in Heber Valley, around Jordanelle Reservoir and in the hills east of Heber Valley. Adding capacity at the plant is expected to resolve existing water quality problems at the plant and in the surrounding area. The primary EIS resource topics related to this project would be water quality, aquatic resources and socioeconomics.

1.7.1.2.6 UDOT Highway 189 Projects. UDOT plans to eventually upgrade Highway 189 from Provo to Heber City. The following upgrades would increase the capacity of Highway 189:

- Murdock to Upper Falls upgrade (completed)
- Upper Falls to Wildwood upgrade (to be constructed from spring 1996 to fall 1998)
- Deer Creek Dam buttressing project (to be constructed in 1997 or 1998)
- Upgrade from the Highway 92 junction to Deer Creek Dam (schedule not determined)
- Upgrade from Deer Creek Dam to Charleston (schedule not determined)
- Upgrade from Charleston to Heber City (schedule not determined)

While not yet funded, the last three upgrades are expected to be funded. Many construction workers and vehicles would be required to complete the upgrades. For example, 200 workers would be needed for the upgrade from Upper Falls to Wildwood, and 250 would be needed for the Deer Creek Dam buttressing project. The UDOT projects would primarily cause transportation, air quality, noise and socioeconomic impacts during construction along Highway 189 — where some construction and recreation traffic would travel under the Proposed Action and DRP alternatives. The primary EIS resource topics that are related to these projects are transportation, wildlife, air quality, noise, wetlands, and socioeconomics.

1.7.2 Projects Not Addressed by the Cumulative Impact Analysis

A Provo River Recreation Study and Conceptual Plan (Bear West 1993) was prepared for the U.S. Bureau of Reclamation (USBR) and the Utah Division of Parks and Recreation (UDP&R). This study defines alternatives for a parkway along the Provo River between Jordanelle and Deer Creek reservoirs — a concept first raised as a recreation enhancement in the Bonneville Unit Municipal and Industrial (M&I) System EIS (USBR 1979). The parkway would be a recreation corridor with land-use restrictions intended to promote a quality recreation experience and to preserve environmental resources. However, since parkway funding and management questions are unresolved and the PRRP would be located in the same river corridor, the cumulative impact analysis assumed the PRRP would be implemented and not the parkway plan.

Other potential projects in the vicinity of the Proposed Action and DRP alternatives include proposed ski resorts on the northern and western edges of Heber Valley. These have not received the necessary funding or permits and are considered too speculative for further analysis in this EIS.

1.8 Proposed Action (WCWEP With Daniel Replacement Pipeline) — Physical Features and Other Characteristics

The Proposed Action is described in this section. The location of the Proposed Action facilities and other features described in this section are shown on Map A-1 in the pocket at the back of the EIS. Section 1.8.1 defines areas where water use changes would occur under the Proposed Action.

The Daniel replacement facilities included in the Proposed Action would be funded by the Mitigation Commission with Section 303 funds, and the other facilities would be funded by CUWCD with Section 207 and 202 funds authorized by CUPCA. The federal government would hold title to all 202 and 303 facilities and local entities (CUWCD or WCSSA No. 1) would hold title to 207 facilities. Local sources would fund 35 percent of the Section 207 and 202 portions of the Proposed Action. The Proposed Action would be constructed by CUWCD. Except for some 207 facilities, the federal government would hold title to the Proposed Action facilities and rights-of-way (ROWs). Operation and maintenance responsibilities for the Proposed Action would be transferred to WCSSA, a local entity. Annual operation, maintenance and replacement costs would be the responsibility of the Mitigation Commission, CUWCD and WCSSA.

Two of the three pumping stations along the Wasatch Canal would pressurize water for the Wasatch and Extension irrigation companies. A 75-hp station would be located at the Coyote Lane canal crossing and a 550-hp station would be located along the southern edge of the Wasatch regulating pond. The third station, a 125-hp unit at 950 North in the Valley Hills subdivision, would be reserved for use by Heber City to deliver non-culinary water (CUP M&I water and canal water) to Valley Hills subdivision for outdoor irrigation.

1.8.1 Irrigation Companies and Changes in Water Application

Map 1-2 shows the location of lands (approximately 7,820 acres) where water application changes would occur under the Proposed Action. The major type of water application change would be a conversion from flood to sprinkler irrigation and a reduction in the volume of water diverted for irrigation.
Table 1-5 shows the acreage where conversion from flood to sprinkler irrigation within each irrigation company would be made possible by the Proposed Action. Of the 3,675 acres that would be converted, about 78 percent is in the Timpanogos and Wasatch irrigation companies. The remainder would be in the Lake Creek, Extension, Spring Creek, Sage Brush and Charleston irrigation companies.
Map 1-3 shows the service areas of these and other irrigation companies that would be affected by the Proposed Action. Map 1-3 is actually a simplification of irrigation company service areas, since some areas are served by a combination of sources and not all companies are shown.

The second type of water application change would be improved water pressure for sprinkler irrigation on lands that are currently sprinkler-irrigated and that would be served by the Proposed Action. Changes in water availability are summarized in Section 3.2 of Chapter 3 and within the service areas of irrigation companies shown on Map 1-3.

Three irrigation companies would not participate in the Proposed Action. They are the Midway and Island Ditch irrigation companies on the west side of the Provo River, and the North Fields Irrigation Company on the east side of the Provo River. Although not a participant, water availability changes would occur within the North Fields as discussed in Section 1.8.6.

Section 3.1.2.1 of Chapter 3 provides more information about on-farm changes that would occur if the Proposed Action is implemented.

1.8.2 Canal Conveyance Facilities, Regulating Ponds and Roads

Three canals — the Timpanogos, Wasatch and Humbug — would be rehabilitated or improved and used for water conveyance of WCWEP and DRP water under the Proposed Action. Map A-1 (in pocket at back of EIS) shows locations of these and other canal facilities in Heber Valley.

Figure 1-1 shows typical cross-sections of existing, rehabilitated, improved and enlarged canals. The Proposed Action would not include the enlargement of any canals. Rehabilitation would restore a canal to excellent working condition. The inside walls and bottom of the canal would be cleared of flow-restricting vegetation and debris and reshaped to reduce flow friction losses, except where the canal has been excavated in rock.

Canal reaches would be improved along reaches where there is a high potential for embankment failure. Four-inch-thick concrete lining or other appropriate methods would be used to strengthen the inside face of the canal on the downslope side. The slope of the concrete lining would vary, depending on site conditions. Temporary, 30-foot-wide access roads would be acquired at approximately 2,000-foot intervals to move construction material to canal reaches where concrete lining would be installed. The canals would not be fenced, but chain-link safety fencing would be installed on the headwalls of structures and steel trashracks, and grates would be installed at the inlets to siphons and turnouts. Improved canals would be slightly shallower than existing conditions, and would be operated at existing capacities or less. Specific canal modifications and related construction procedures are described in the following sections.

1.8.2.1 Description of Facilities

1.8.2.1.1 Timpanogos Canal. A total of 9.5 miles of the Timpanogos Canal (80 percent of its total length) would be rehabilitated and improved in areas that are unstable on the down-slope side. About 1.9 of the 9.5 miles of canal would be improved with new concrete lining, while the remainder would be rehabilitated. Table 1-6 shows where concrete lining would be used on the Timpanogos Canal by station number (see Map A-1 in pocket at back of EIS for station number locations). The Timpanogos Canal would be used from the Timpanogos Diversion near Jordanelle Dam to near the crossing of Lake Creek east of Heber City as shown on Map A-1.

The Timpanogos Diversion structure would be reconstructed near the base of Jordanelle Dam. This structure is located on the afterbay below the dam on the old river channel. It is a few hundred feet east of the main Provo River channel that was relocated by the USBR. Map A-1 (see pocket at back of EIS) shows the location of the Timpanogos Diversion. Figure 1-2 shows a site plan and cross-section for proposed reconstruction of the Timpanogos Diversion under the Proposed Action and DRP alternatives. A concrete control structure would be reconstructed in the same location as the existing concrete sill and flashboards. A low concrete sill would extend across the old river channel and maintain a proper water surface elevation in the afterbay without the need for flashboards. A new, gated version, capable of maintaining a constant diversion rate under fluctuating afterbay water levels, would be constructed in the control structure at the head of the Timpanogos Canal. The capacity of the Timpanogos Diversion would be approximately 80 cubic feet per second (cfs).

In addition to concrete lining and reconstruction of river diversions, the Proposed Action would include the following improvements to the Timpanogos Canal:

- Existing water control structures and turnouts would be removed if they are no longer needed or if they would interfere with water operations

- Spillways would be added to the canal to discharge excess water into existing drainages and to recapture water in other canals. The final location and size of the spillways would be determined during design of the Proposed Action.

- Three pumped turnouts and two gravity lateral turnouts would be constructed along the canal to deliver water

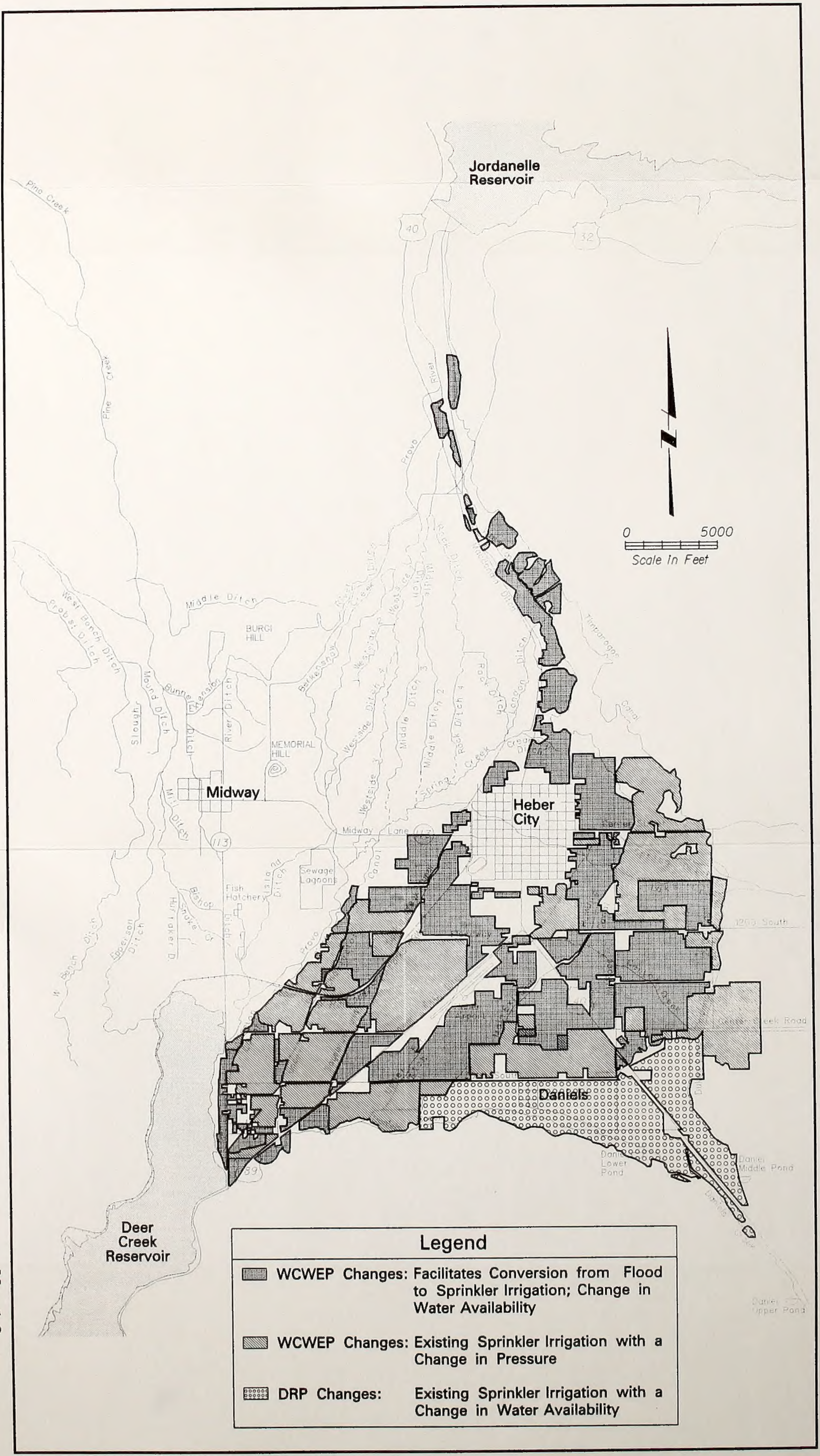
- Water level control structures would be constructed in the canal immediately below the turnout locations to maintain proper water elevations in the canal

A regulating pond would be constructed at the terminus of the Timpanogos Canal. The 150-by-600-foot pond, which would cover approximately 2.5 acres at a maximum depth of 10 feet, would be enclosed by a chain-link fence. In addition to water regulation benefits, the pond would reduce the accumulation of debris at pumping station intakes. Figure 1-3 shows a typical regulating pond plan and cross-section.

1.8.2.1.2 Wasatch and Humbug Canals. A total of 5.8 miles of the Wasatch Canal (80 percent of its total length) from the Provo River to the junction with the Humbug Canal would be rehabilitated under the Proposed Action. Rehabilitation would be limited to minimal cleaning, brush trimming and removal of existing structures that would interfere with Proposed Action facilities.

New radial gates would be constructed at the Wasatch Diversion with a capacity of 225 cfs (Map A-1). Turnouts from the Wasatch Canal to Rock and MacDonald ditches that serve the North Fields Irrigation Company would be reconstructed. The Rock Ditch turnout would have a capacity of approximately 100 cfs, and the MacDonald Ditch turnout would have a capacity of 5 cfs. The Wasatch Canal would operate at a maximum capacity of 100 cfs below the North Fields turnouts, about the same as its existing capacity. The operating capacity of the canal near the junction with the Humbug Canal would be approximately 68 cfs, about the same as its existing capacity.

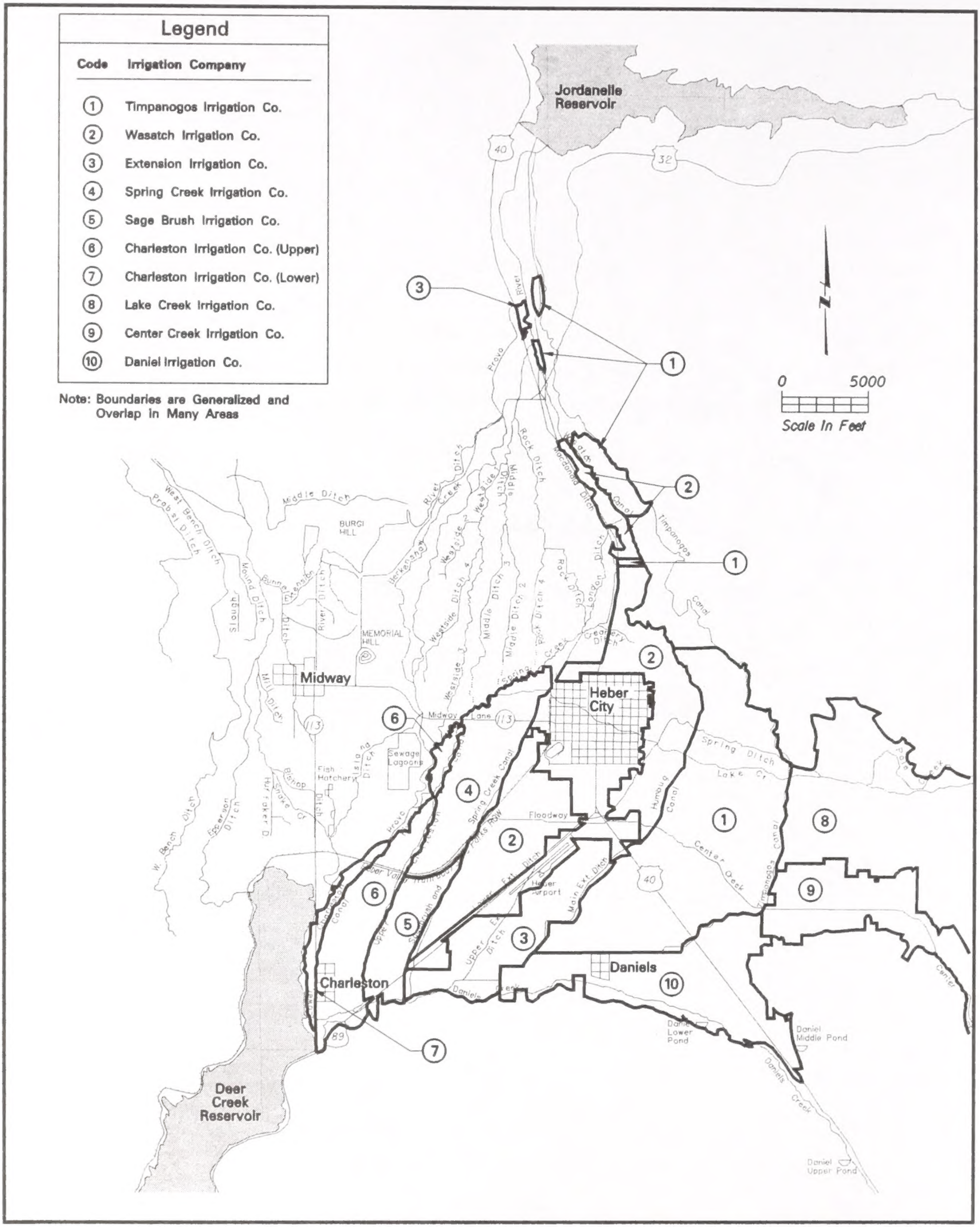
Existing water control structures and turnouts would be removed if they are no longer needed or if they would interfere with operations. After modifications, the Wasatch Canal only would include the following turnouts: the Rock Ditch, MacDonald Ditch, London Ditch (new), Creamery Ditch (new), Coyote Lane (new), Valley Hills (new) and Humbug Canal turnouts (2 new). The Rock,



Map 1-2
Location of Lands Where Water
Application Changes Would Occur
Under the Proposed Action

Table 1-5
Area Where Conversion From Flood to Sprinkler Irrigation Would be Made Possible by Proposed Action (WCWEP With Daniel Replacement Pipeline)

Irrigation Company	Farmed Acres
Timpanogos	1,456
Wasatch	1,395
Extension	235
Spring Creek	253
Sage Brush	142
Charleston (Upper)	137
Charleston (Lower)	55
Lake Creek	2
Total Area	**3,673**



Map 1–3
Service Areas of Heber Valley Irrigation Companies
That Would Participate in the Proposed Action

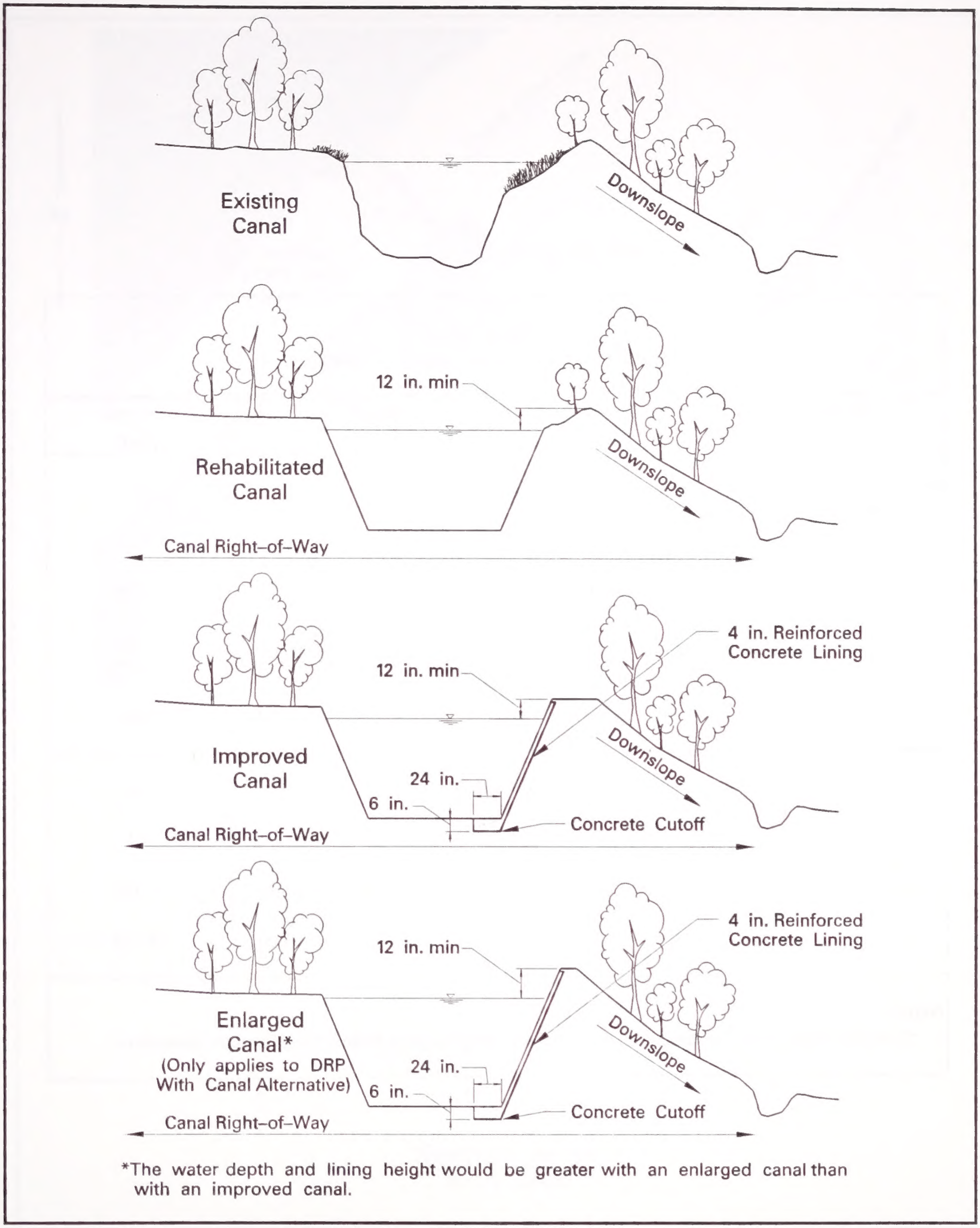
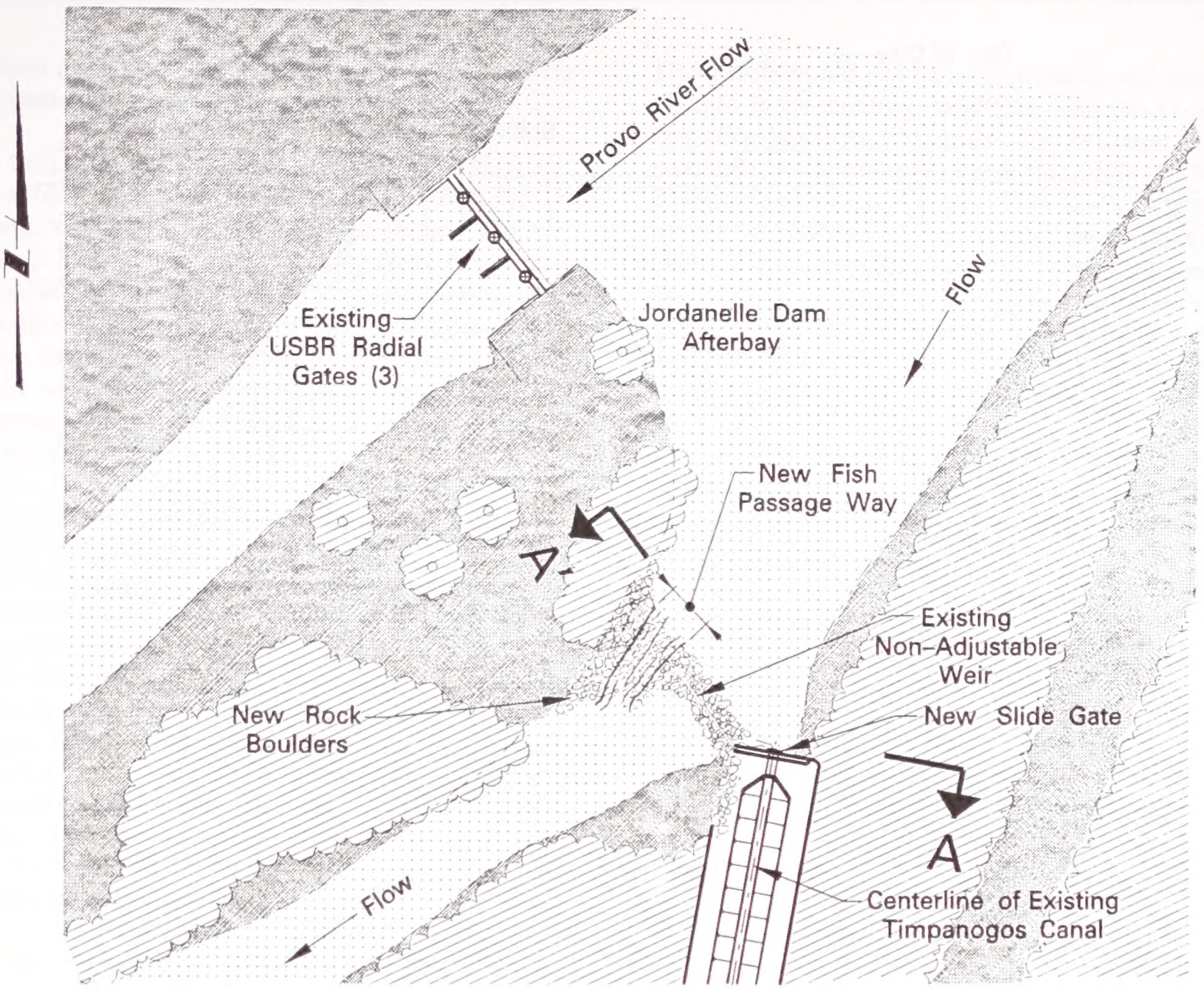


Figure 1-1
Typical Canal Cross-Sections

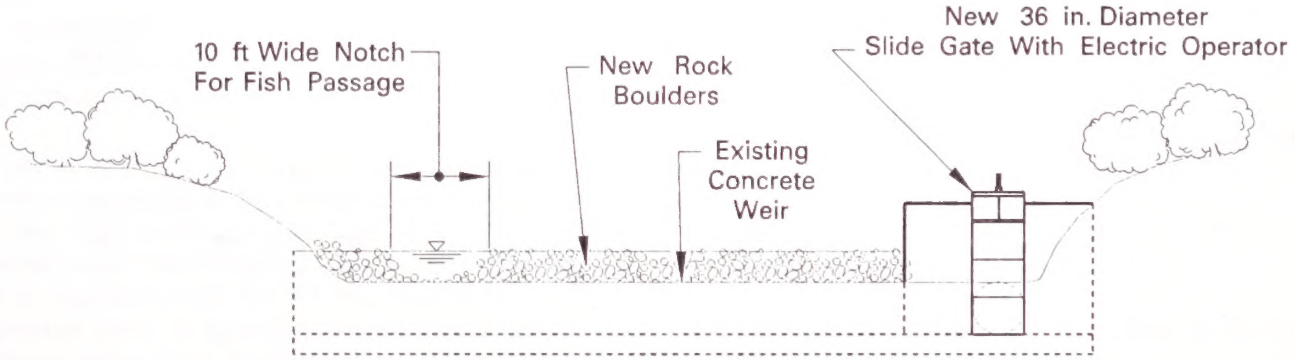
Table 1-6
Locations of Canal Concrete Lining

Alternative*	Canal	Reach	Length (feet)
Proposed Action (WCWEP with Daniel Replacement Pipeline)	Wasatch Canal	None	NA
	Humbug Canal	None	NA
	Timpanogos Canal	Station 16,200 to Station 20,500	4,300
		Station 30,500 to Station 31,600	1,100
		Station 32,900 to Station 36,145	3,245
		Station 43,500 to Station 44,700	1,200
		Total	9,845
Daniel Replacement Project With Canal Alternative	Wasatch Canal	None	NA
	Humbug Canal	None	NA
	Timpanogos Canal	Station 14,600 to Station 49,000	34,400
		Total	34,400

Notes:
*Concrete lining would not be included in the Daniel Replacement Project With Pipeline Alternative.

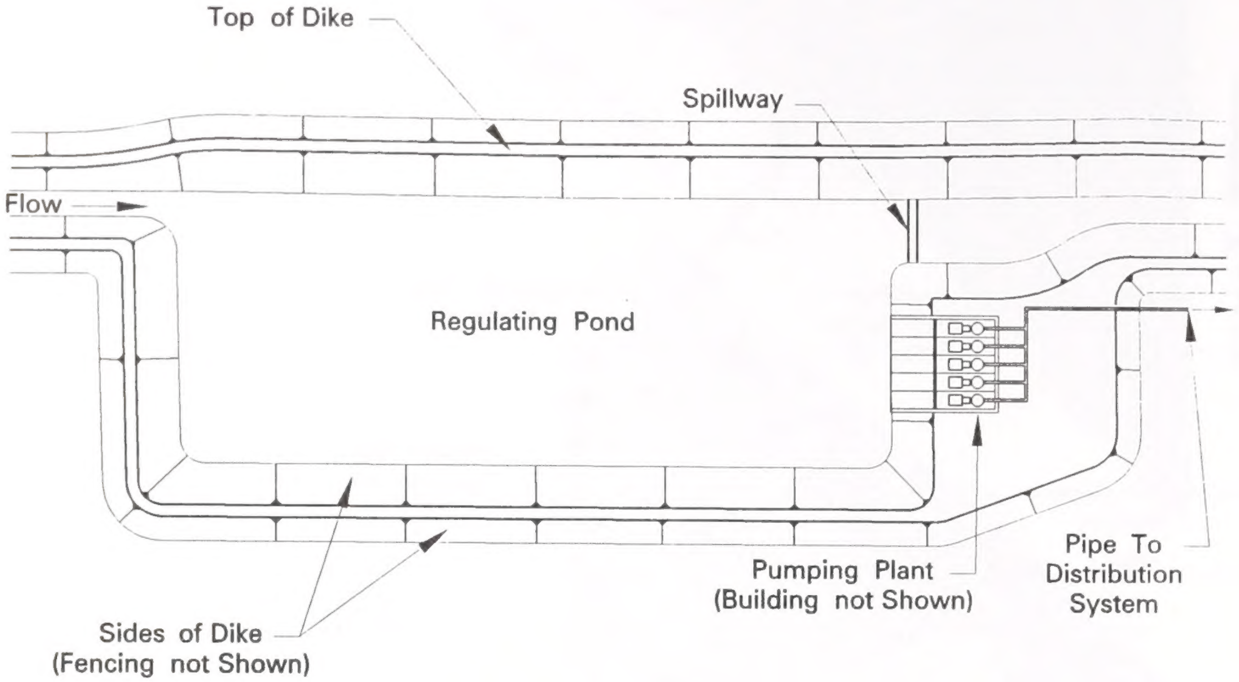


Plan
(Not to Scale)

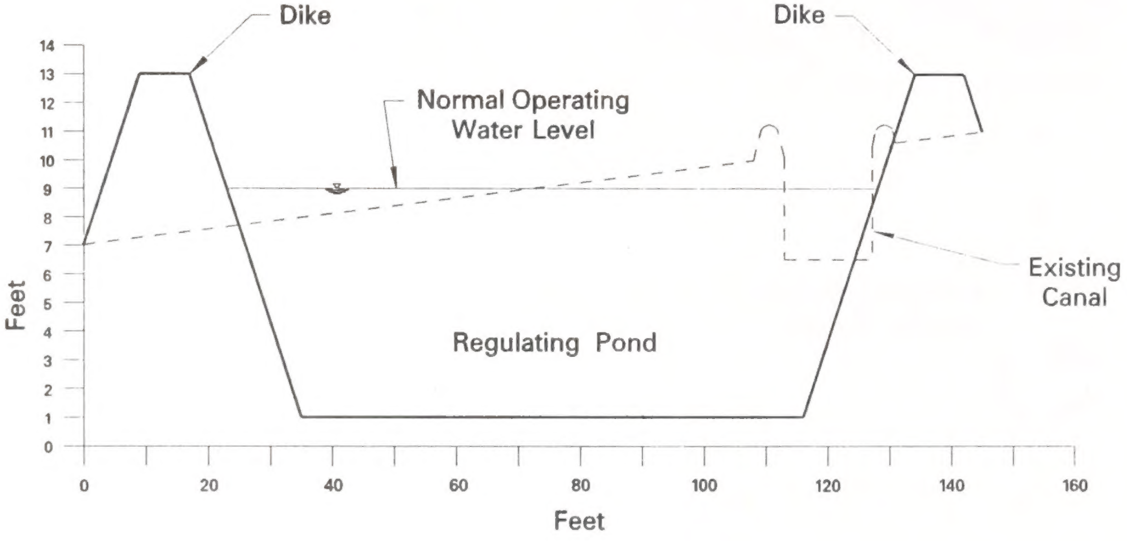

New 36 in. Diameter Slide Gate With Electric Operator
10 ft Wide Notch For Fish Passage
New Rock Boulders
Existing Concrete Weir

Section A′–A
(Not to Scale)

Figure 1–2
Timpanogos Diversion Site Plan and Cross-Section
Under the Proposed Action and DRP Alternatives


Top of Dike
Spillway
Flow
Regulating Pond
Pipe To Distribution System
Pumping Plant (Building not Shown)
Sides of Dike (Fencing not Shown)

Plan of Regulating Pond with Pumping Plant and Spillway



Cross–Section of Regulating Pond

Figure 1–3
Schematic Plan and Cross–Section of Typical Regulating Pond

London and Creamery ditch turnouts would deliver supplemental instream flow to these streams.

The first mile of the Humbug Canal would be used for water conveyance. The canal has problems with aquatic vegetation growth because of the wide, shallow bottom and slow velocity (less than 1 foot per second). Channel hydraulics would be improved by excavating the bottom of the canal by as much as 1 foot in some areas to a uniform slope, which would steepen the grade in slow flowing areas, and removing or lowering concrete structures that block and slow the flow.

The top of the Humbug Canal embankment would be leveled and widened, and excavated material from the canal bottom would be used to construct a 15-foot-wide operation and maintenance (O&M) road along the canal. The 1-mile-long road (the only O&M road included in the Proposed Action), would be on the east side of the canal east of Mill Road, and on the west side of the canal west of Mill Road. No O&M road would be constructed along the canal adjacent to Mill Road. The O&M road would be seeded with short-stemmed, low-maintenance grass, and use would be limited to canal operations staff and adjacent landowners.

The Wasatch regulating pond would be constructed at the beginning of the Humbug Canal between Spring Ditch and the Lake Creek crossing. It would be similar in size and shape to the Timpanogos regulating pond and would regulate flows for lands served by the Proposed Action south of Heber City. Figure 1-3 in Section 1.8.2.1.1 shows a schematic plan and cross-section of the regulating pond. A pumping station and pipeline distribution system would distribute water from this pond.

The Humbug Canal would discharge into the existing irrigation regulating pond (Humbug regulating pond) near the 1200 South crossing. This pond would be acquired under the Proposed Action, deepened and used to regulate water for WCWEP lands in the Charleston area. A gravity pipeline lateral would distribute water from this pond.

1.8.2.1.3 Sagebrush and Spring Creek Canal. Under the Proposed Action, the first 1.7 miles of the Sagebrush and Spring Creek would convey supplemental instream water from Spring Creek to Lake Creek below Heber City through an agreement with canal owners. This reach would not be rehabilitated, and would operate in its existing condition with the same irrigation turnouts. Supplemental instream flow would be delivered to a new 6 cfs turnout to be constructed at Lake Creek. This reach of the canal would be operated at a maximum capacity of 15 cfs, about 70 percent less than the existing capacity of about 50 cfs. The diversion structure from Spring Creek would be removed and replaced with a similar gated structure to provide fish passage and improved control of the flow in Spring Creek.

1.8.2.1.4 Canals Used for Drainage. Several canals, ditches and laterals would no longer be used to convey irrigation water once the Proposed Action is operating. However, existing owners could continue to maintain the ditches for snowmelt and stormwater drainage. The following canals, ditches and laterals would no longer be needed to convey irrigation water:

- The Timpanogos Canal south of the Timpanogos regulating pond, and all laterals extending from the Timpanogos Canal
- The Wasatch Canal extending southwest from the junction with the Humbug Canal, and all laterals extending from the Wasatch Canal
- The Humbug Canal south of 1200 South and all laterals
- The Main Extension Ditch and all laterals
- The Upper Extension Ditch and all laterals
- The Lower Extension Ditch and all laterals
- The Sagebrush and Spring Creek Canal south of 1200 South and all laterals
- The Upper Charleston Canal south of 1000 South and all laterals
- The Lower Charleston Canal south of the 2400 South crossing

These canals, ditches and laterals would be used under the Proposed Action for emergency spills in case of sudden power outages or pumping station shutdowns. Excess water flow in the Timpanogos, Wasatch and Humbug canals would be discharged into the discontinued canals and would quickly dissipate and recharge into the groundwater table.

1.8.2.2 Rights-of-Way

The term "rights-of-way" (ROW) is used to describe the fee title, permanent easement and temporary easement areas needed to construct, operate and maintain the Proposed Action. ROWs would need to be acquired along existing canals used for water conveyance under the Proposed Action because the existing canals do not have defined ROWs. The canals have been operated continuously since they were constructed by the irrigation companies approximately 100 years ago. ROW would be acquired through negotiated contracts or the exercise of eminent domain, if necessary. All ROW for facilities used to convey and pump Daniel replacement water and for canal and pumping stations needed to operate and maintain the Proposed Action would be purchased in fee title or permanent easements. Title would be held by the United States. Permanent easements would be purchased for distribution pipelines that would not convey DRP water.

Fee title means the purchase of land, free and clear of encumbrances. Any improvements within the area acquired would be relocated or licensed to remain. Ownership of land in permanent easement areas would remain in the name of the seller. Use of the land within the easement would be permanently restricted to uses that do not interfere with the operation or maintenance of facilities. CUWCD and its agents would be permitted to enter permanent easement areas to operate, maintain and replace facilities. Temporary easements would be used for construction access and work area for several years.

Table 1-7 summarizes the ROW requirements for the Proposed Action and DRP alternatives by facility type. The Proposed Action would require approximately 390.3 acres of ROW, comprised of 151.9 acres of fee title acquisition, 127.4 acres of permanent easement and 111.0 acres of temporary easement.

A total of 73.1 acres would be acquired along the Timpanogos Canal for a ROW of 65 feet wide or less in most areas, and a maximum of 105 feet where the canal crosses Highway 32. A 175-foot-wide area 30 feet long (2.5 acres) between stations 49,720 and 50,350 would be excavated near the Lake Creek crossing for a regulating pond. It would not be necessary to acquire temporary easements for additional work area along the canal because rehabilitation and improvement work would be done from inside the canal. Approximately 6.9 acres of temporary ROW would be acquired to provide construction access to the canal from existing roadways at pumping station and control structure locations. Access roads would be required in canal improvement areas at approximately 2,000-foot intervals to move construction materials to the canal. These would be about 30 feet wide and used only for construction access where existing roadways are not available.

About 44 acres of ROW would be purchased along the Wasatch Canal, ranging from 45 to 90 feet wide. Temporary easements would not be needed.

A total of 12.1 acres would be acquired along the Humbug Canal, including 6.7 acres for regulating ponds and 5.4 acres for the canal. Canal ROW widths would range from 30 to 60 feet. An additional 3.1 acres of temporary easement would be acquired for construction staging during rehabilitation of the canal and construction of the O&M roadway.

1.8.2.3 Construction Procedures

The contractors would establish two 5- to 10-acre construction yards for a temporary field office and storage of equipment and supplies. One would be for diversion and control structures, Daniel replacement pipeline facilities and canal work. This area would likely be close to the alignment of the Timpanogos Canal between Center Street and 3000 South, along a road that is easily accessible. The other yard, which would serve the contractor constructing the distribution pipelines, would likely be near Heber City, but the location has not been determined.

Table 1-8 shows the typical noise levels associated with construction equipment and pumping stations under the Proposed Action and DRP alternatives. Table 1-9 shows the typical air emissions associated with construction equipment that would be used to construct the Proposed Action and alternatives. Canal rehabilitation and improvement work would be performed by a crew that would begin at one end of the canal and proceed to the other end. Additional crews would form and pour structures and set the gates. Work would last approximately three months in any location, and construction procedures

Table 1-7
Summary of Rights-Of-Way for the Proposed Action and DRP Alternatives

Alternative	Facility Type	Fee Title (acres)	Permanent Easement (acres)	Temporary Easement (acres)	Total (acres)
Proposed Action (WCWEP With Daniel Replacement Pipeline)	Canal	119.7	0.0	10.0	129.7
	Pipeline	22.0	127.4	101.0	250.4
	Pump Station	1.0	0.0	0.0	1.0
	Regulating Pond	9.2	0.0	0.0	9.2
	Totals	151.9	127.4	111.0	390.3
Daniel Replacement Project With Pipeline Alternative	Pipeline	55.5	0.0	39.9	95.4
	Pump Station	0.3	0.0	0.0	0.3
	Totals	55.8	0.0	39.9	95.7
Daniel Replacement Project With Canal Alternative	Canal	87.8	0.0	33.0	120.8
	Pipeline	23.2	0.0	11.3	34.5
	Pump Station	0.3	0.0	0.0	0.3
	Totals	111.3	0.0	44.3	155.6

Table 1-8
Typical Noise Levels Associated with Construction Equipment and Pumping Stations Under the Proposed Action and DRP Alternatives

Temporary Construction Equipment	Horsepower	Daily Usage	Noise Levels	
			Range of Noise Level @ 50 ft (in dBA)[a]	Nominal Noise Level, Leq @ 50 ft (in dBA)
Air Compressor	85	8 hours	68 to 87	81
Backhoe-Cat 426	70	8 hours	78 to 84	79
Compactor-Cat 816B	210	8 hours	72 to 96	84
Compactor-Vibratory	100	8 hours	78 to 84	79
Compactor-14 in. Whacker	5	8 hours	84 to 90	86
Crane-25 Ton	160	8 hours	75 to 95	80
Crane-60 Ton	200	8 hours	75 to 95	80
Dozer-Cat D7	215	8 hours	72 to 96	86
Excavator-Cat 235	215	8 hours	71 to 93	85
Excavator-Cat 245	325	8 hours	71 to 93	85
Forklift	130	8 hours	76 to 85	80
Generator	40	8 hours	69 to 81	74
Loader-Cat 966C	200	8 hours	71 to 96	82
Motor Grader-Cat 14G	200	8 hours	73 to 95	85
Pickup (on site use only)	130	50 mi/day	76 to 85	80
Scraper-Cat 621	330	8 hours	73 to 95	88
Scraper-Cat 623	330	8 hours	73 to 95	88
Trencher	500	8 hours	72 to 96	86
Truck - Concrete Mixer	250	50 mi/day	70 to 90	85
Truck - Concrete Pump	200	8 hours	74 to 84	82
Truck - Rear Dump	350	50 mi/day	70 to 92	85
Truck - Flatbed	175	50 mi/day	76 to 85	80
Truck - Mechanics	175	50 mi/day	76 to 85	80
Truck - Pipe	250	50 mi/day	70 to 92	85
Truck - Water	250	8 hours	70 to 92	85
Water Tanker	450	8 hours	79 to 88	84
Permanent Facilities				
Pumping Stations	15-685	24 hours	b	b

Notes:

[a] dBA is A-weighted decibel, which is a scale measuring human response to loudness.

[b] Pumping stations would be enclosed in pump buildings that would minimize noise levels.

Table 1-9
Typical Air Emissions Associated With Construction Equipment Under the Proposed Action and DRP Alternatives

Equipment Type	Typical Emissions Based on 8 Hours of Operation Per Day		
	NOx (lb/month)	SOx (lb/month)	PM10 (lb/month)
Air Compressor	163.2	27.2	13.6
Backhoe - Cat 426	704.0	64.0	48.0
Compactor - Cat 816B	806.4	67.2	50.4
Compactor - Vibratory	384.0	32.0	24.0
Compactor - 14 in. Wacker	0.5	0.4	6.8
Concrete Vibrator	384.0	32.0	24.0
Crane - 25 ton	281.6	51.2	38.4
Crane - 60 Ton	352.0	64.0	48.0
Dozer - Cat D7	791.2	68.8	34.4
Excavator - Cat 235	421.1	68.8	51.6
Excavator - Cat 245	1248.0	110.2	78.0
Forklift	644.8	41.6	31.2
Generator	115.2	12.8	6.4
Loader - Cat 966C	704.0	64.0	48.0
Motor Grader - Cat 14G	672.0	64.0	64.0
Pickup	2.3	0.6	15.0
Scraper - Cat 621	1003.2	105.6	79.2
Scraper - Cat 623	1003.2	105.6	79.2
Trencher	1760.0	160.0	120.0
Truck - Concrete Mixer	960.0	80.0	40.0
Truck - Concrete Pump	768.0	64.0	48.0
Truck - Rear Dump	1344.0	112.0	84.0
Truck Flatbed	672.0	56.0	42.0
Truck - Mechanic's	672.0	56.0	42.0
Truck - Pipe	960.0	80.0	60.0
Truck - Water	960.0	80.0	60.0
Water Tanker	1728.0	144.0	108.0

would differ for the canals as described in Sections 1.8.2.3.1 and 1.8.2.3.2.

1.8.2.3.1 Procedures for Timpanogos and Wasatch Canals. The canal ROW would not be cleared along the Timpanogos and Wasatch Canals because there would be no O&M roads adjacent and parallel to the canals. The contractor would be required to work from inside the canals when they are dry. Construction equipment would be confined to narrow widths and only move in one direction. Access would only be available for operation and maintenance of pumping stations, regulating ponds and gate structures.

The contractor would first clean and trim vegetation inside the canal, then establish access points where the canal would be lined. Workers would then prepare the canal embankment, place the lining, then build new structures. Vehicles would use 30-foot-wide temporary access roads every 2,000 feet to transport materials to the work area in the improved canal reaches. The location of the access roads would depend on land ownership, roads, vegetation cover and other surface features at the time of ROW acquisition. Given the confined work area, restoration work would be minimal and limited to the temporary access roads. Soil cleaned from the canals would be placed on adjacent embankments, if practical, or hauled for use elsewhere in the work area. Cottonwood rootstock would be salvaged when practical. Other debris would be hauled to an appropriate disposal site.

1.8.2.3.2 Procedures for Humbug Canal. The entire canal ROW would be cleared and used as a work area along the Humbug Canal. The ROW generally is treeless and grassy, and would require minimal bulldozing. Canal stations would then be staked in the field, and the work area wetted as necessary to keep soil moist for construction. Crews would then excavate the canal to final dimensions, construct a widened embankment to provide a permanent O&M road, then form and pour concrete structures. Water trucks would dampen the ROW for dust control, and the work area would be restored and revegetated after completion.

1.8.3 Pipeline Conveyance Facilities

The Proposed Action would include approximately 42 miles of new buried pipeline in Heber Valley that would convey and distribute water to irrigation companies and farms. An additional 3 miles of pipeline would be constructed in the Strawberry Valley for stock watering purposes to offset the loss of livestock watering from the existing canals. Map A-1 (see pocket at back of EIS) shows locations of pipelines included in the Proposed Action.

Figure 1-4 is a typical pipeline cross-section and construction area schematic. The pipelines would be placed in trenches and buried, and the excavated material temporarily stockpiled along the trench. Table 1-10 shows pipeline length by size class that would be used for the Proposed Action and DRP alternatives.

1.8.3.1 Description of Facilities

The Proposed Action would consist of a pipeline conveyance and distribution system to distribute water from the Timpanogos and Wasatch Canals. Pipelines would convey water from the Timpanogos Canal to lands that would receive water under the Proposed Action and to the regulating ponds of DIC. Additional pipelines would distribute water from the Wasatch Canal to only lands that would receive water under the Proposed Action.

The Daniel Replacement Pipeline would begin at a pumping station on the Timpanogos regulating pond and would consist of three segments: a pipeline leading to the Daniel Lower Pond; a booster station and pipeline from the main pipeline to the Daniel Middle Pond; and a booster pump on the Daniel Middle Pond with a 500-foot-long pipeline connection to the existing pipeline delivering water from the Daniel Upper Pond.

The Daniel Replacement pipeline would follow the present alignment of the Timpanogos Canal to Mill Road, and would be used in this reach to jointly deliver water to DIC and other lands. It would range in diameter from 42 inches near the Timpanogos regulating pond to 24 inches near the Mill Road vicinity. A 16-inch-diameter pipeline would extend along Mill Road from the Timpanogos Canal vicinity to the Daniel Lower Pond. The existing canal would remain a drainage ditch after installation of the pipeline. The 30-inch-diameter Daniel Middle Pond pipeline branch and 12-inch-diameter Daniel Upper Pond pipeline branch would convey Daniel replacement water from the Daniel Lower

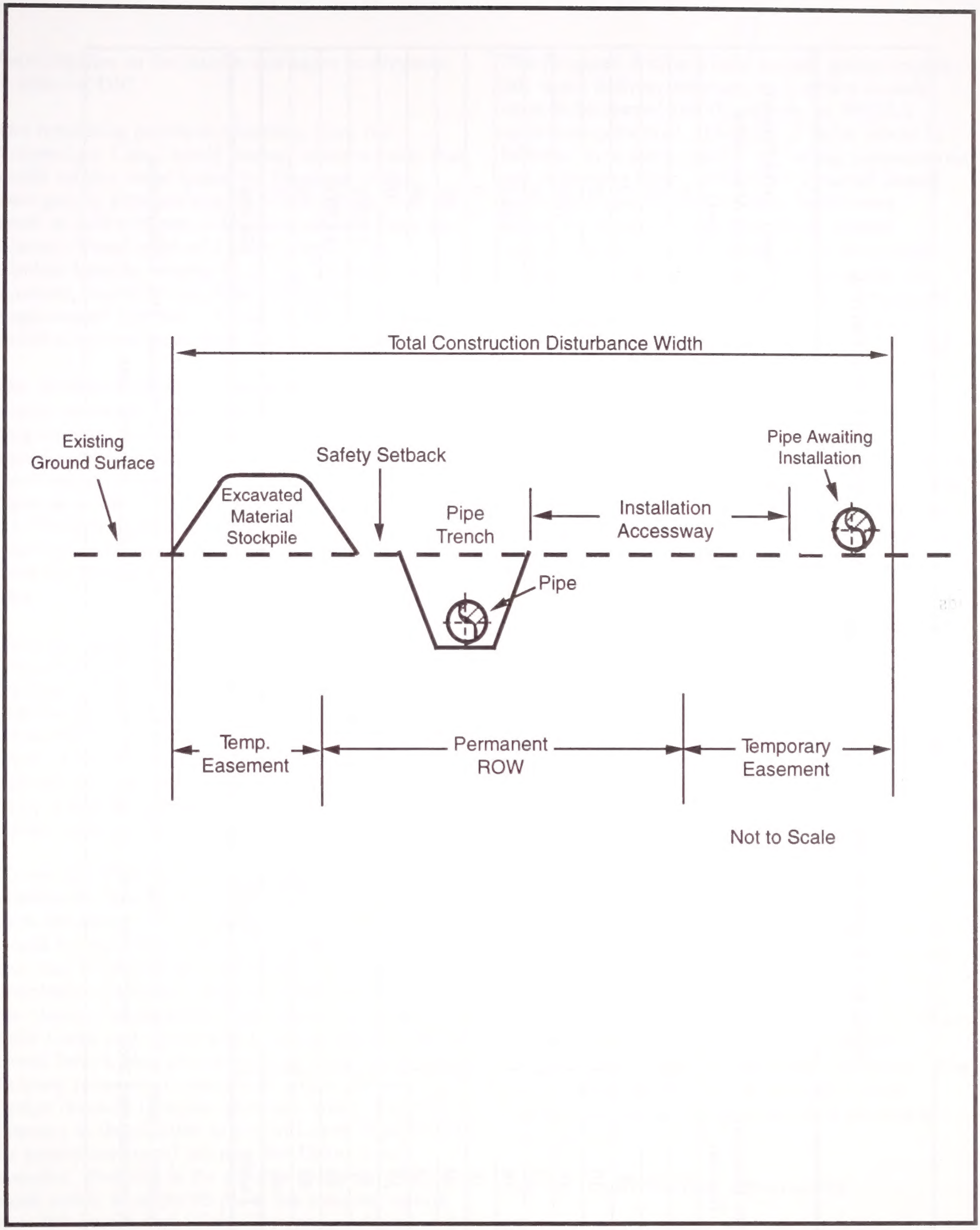


Figure 1-4
Typical Pipeline Cross-Section and Construction Area Schematic

Table 1-10
Pipeline Length By Size Class for the Proposed Action and DRP Alternatives

Pipe Diameter (inches)	Proposed Action (WCWEP with Daniel Replacement Pipeline) (feet)	Daniel Replacement Project With Pipeline Alternative (feet)	Daniel Replacement Project With Canal Alternative (feet)
4	15,964	0	0
6	33,425	0	0
8	22,808	0	0
10	25,691	0	0
12	34,472	500	500
14	898	3,300	0
16	14,867	0	4,616
18	28,274	0	0
20	2,556	0	0
24	9,701	0	0
27	0	6,646	0
30	12,310	0	7,930
36	9,199	52,349	14,960
42	7,306	0	0
48	6,500	0	0
Totals	**223,971**	**62,795**	**28,006**

Notes:

An additional 3 miles of 2-inch pipeline would be constructed in the Strawberry Valley for stock water purposes. This 3-mile pipeline would be constructed under the Proposed Action and DRP alternatives and is not included in the above totals.

Pond pipeline to the middle and upper conveyance systems of DIC.

The remaining pipelines extending from the Timpanogos Canal would convey water to lands that would receive water under the Proposed Action. Two gravity pipeline laterals would extend from the canal to deliver water to land downstream from the Wasatch Canal north of Center Street. Five pipeline laterals, ranging from 4 to 24 inches in diameter, would branch from the Daniel Replacement Pipeline,. About 10 miles of pipeline would distribute water from the Timpanogos Canal.

The Wasatch/Humbug pipeline distribution system would consist of approximately 26 miles of pipe, ranging from 4 to 48 inches in diameter. One pipeline would extend from a pumping station on the Wasatch Canal near Coyote Lane; a second pipeline would extend from a pumping station on the Wasatch regulating pond near the Center Street crossing; and a third gravity pipeline would extend from the Humbug regulating pond to the Charleston area.

Pipelines larger than 24 inches in diameter likely would be steel, lined and coated with mortar. Pipelines 24 inches and smaller likely would be polyvinyl-chloride (PVC). Manhole and valve covers would extend to the surface from larger steel pipes. Four-foot-high posts with cathodic wiring and test switches would be placed approximately every 1,000 feet along the pipeline, and short steel marker posts would be installed near valves.

In-line shutoff valves would be installed along pipeline laterals, as necessary, and at lateral and farm turnouts. Approximately 11 pressure reducers would be required to maintain maximum pressure of less than 70 pounds per square inch (psi) in distribution pipelines. Pipeline laterals connecting the Daniel Replacement Pipeline to the existing Lake Creek and Center Creek irrigation pipelines would have higher pressures of up to 90 psi to match existing pressure at connection points and maintain design pressure to higher elevation areas. Maximum pressure in the pipeline to Daniel Lower Pond would be approximately 40 psi near the Dukes Lane crossing. Pressure in the pipeline to Daniel Middle Pond would be about 95 psi at the pumping station near the intersection of the Timpanogos Canal and Dukes Lane and drop to less than 5 psi near the Daniel Middle Pond.

The Proposed Action would include approximately 307 water delivery turnouts, each with a shutoff valve to be opened and closed only by WCSSA operations personnel. The shutoff valve would be followed by a meter capable of reading instantaneous and cumulative flow, followed by a second shutoff valve to be opened and closed by landowners. Figure 1-5 shows a typical farm above-ground turnout and the location of the valves and meter. Below-ground turnouts would be constructed with access to the valves and meter. Landowners would be responsible for connecting to project turnouts and furnishing, operating and maintaining pipe and sprinkler equipment beyond these points.

1.8.3.2 Rights-of-Way

Land needed for the permanent ROWs of the Daniel Replacement Pipeline would be purchased in fee title or permanent easement by the federal government. Additional temporary easements would be acquired to provide work area for construction and temporary storage of excavated material and pipe material. The total work area available to the contractor would be the sum of the permanent and temporary ROWs.

Figure 1-4 in Section 1.8.3 illustrates the total pipeline construction disturbance area and the permanent ROW, which would vary in width based on pipe diameter. The permanent ROW would include just enough area to operate and maintain the pipeline. Only temporary easements or ROWs would be needed during construction to provide sufficient work area width for the contractor to install pipe.

The Daniel Replacement Pipeline would require approximately 22 acres of fee title acquisition and 18 acres of temporary easement. The total length of the Daniel Replacement Pipeline would be about 5 miles. The Proposed Action distribution pipelines would require about 127 acres of permanent easement and 83 acres of temporary easement. The largest pipe size, 48 inches in diameter, would require a work area 85 feet wide and a permanent ROW 40 feet wide.

1.8.3.3 Construction Procedures

1.8.3.3.1 Typical Pipeline Construction Procedures. Figure 1-6 illustrates typical pipeline construction procedures. First, the construction

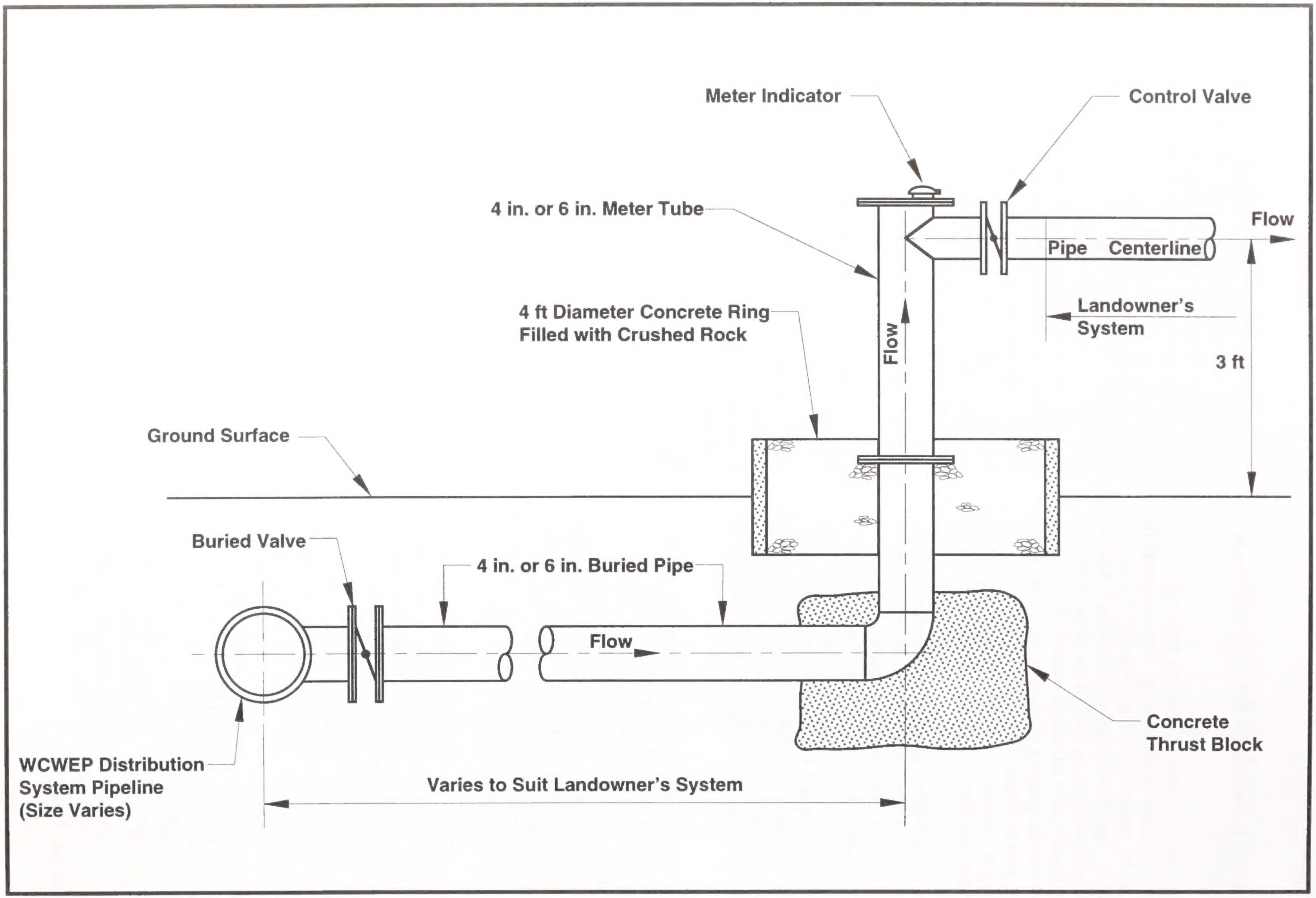


Figure 1-5
Typical Farm Above-Ground Turnout

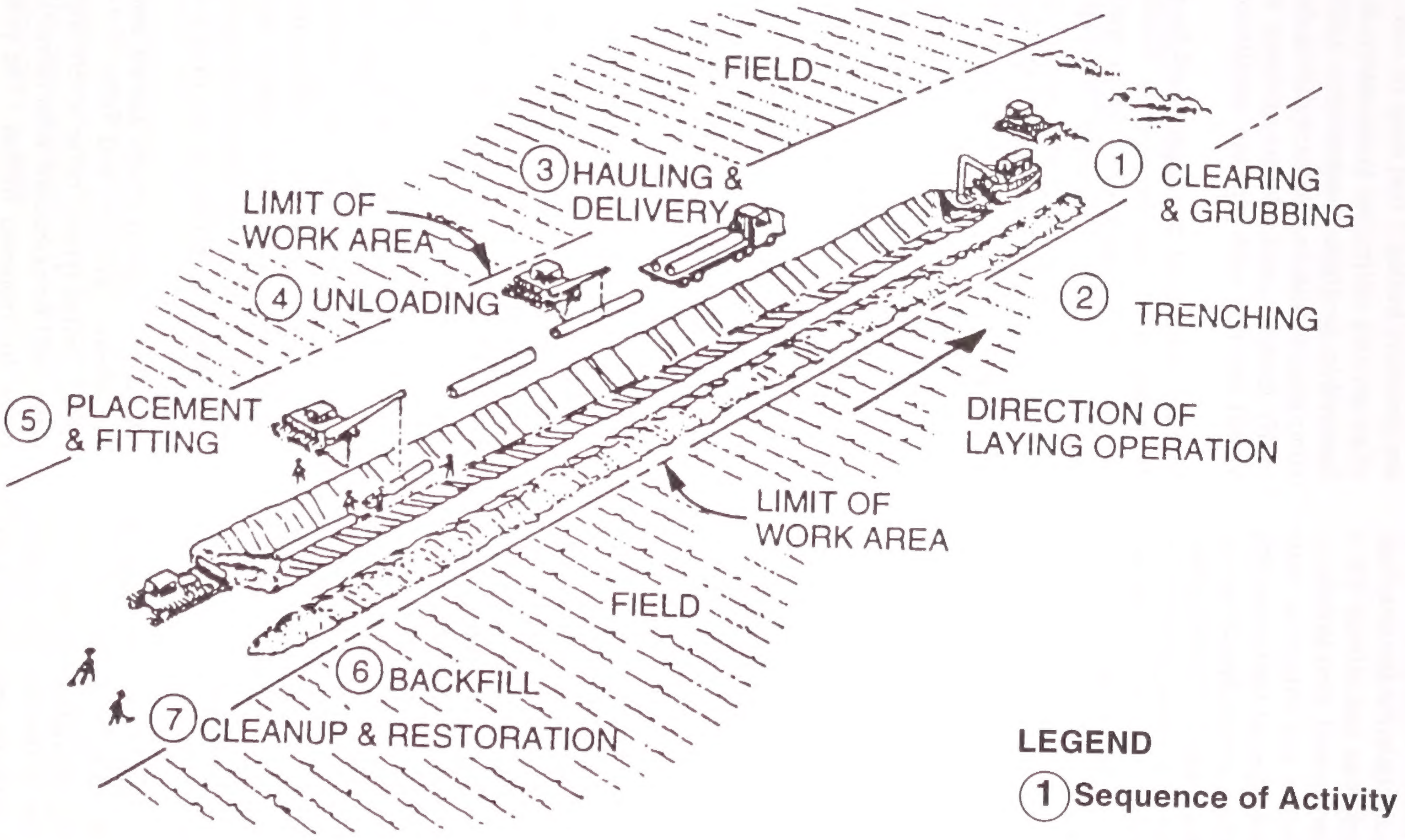


Figure 1-6
Typical Pipeline Construction Procedures

area would be cleared of vegetation or obstructions that would interfere with pipe installation (see Number 1 in sequence). Workers would install survey stakes and bulldoze or grade the top one foot of soil to the side of the work area and salvage the soil for site restoration. They would then install temporary dirt irrigation ditches and irrigation water crossings, which would allow adjacent landowners to continue watering their land on both sides of the work area. In wetland areas, instead of clearing the work area, existing vegetation would be protected by a fabric overlay during construction. Excavated dirt would be temporarily placed on top of the fabric and removed following completion of construction. Additional information regarding construction procedures in wetland areas is included in Section 1.12.9.

After clearing the area, a trench would be excavated with a bottom width 2 to 3 feet wider than the outside diameter of the pipe to be installed (Number 2 in sequence). Workers would deliver and unload the pipe along the pipeline route (Numbers 3 and 4 in sequence), then place the pipe in the trench and backfill the trench with native material, or imported material in areas where native material is unsuitable (Numbers 5 and 6 in sequence). Imported trench material would be hauled from local gravel pits with dump trucks. In most areas, the trench would be filled with 6 inches of pea gravel to provide proper bedding. The backfill would be compacted to within 1 foot of the ground surface, providing at least 3 feet of cover over the pipe after installation. The trenching, pipe installation and backfill operations would advance at a rate of about 500 feet per day for large pipes and 2,000 feet per day for small pipes. The contractor would likely have two pipe-laying crews working during the summer. Cleanup and restoration would consist of finish grading the work area, removal of excess construction materials and revegetation of the soil surface to prevent erosion (Number 7 in sequence).

The distribution pipeline contractor would establish a construction yard of 5 to 10 acres for storing equipment and supplies and staging construction activities. The yard — one of the two identified in Section 1.8.2.3 — would likely be near Heber City in a yet-to-be-determined location close to state highway access.

1.8.3.3.2 Utility Crossings. Existing utility lines would be located and carefully marked before trench excavation. A minimum vertical clearance of 1 foot would be maintained between the pipeline and existing buried utility lines. Pipelines would normally be installed under existing utilities, which are generally buried 3 feet deep or less. If relocation of an existing utility line is necessary, it could be lowered to facilitate construction. Utility companies would be contacted during design to verify locations and relocate or lower utilities that would interfere with pipeline installation.

In most cases, road crossings would be excavated from the surface and the pipeline installed in two stages. First, flaggers would detour traffic to a single lane near one side of the road. Workers would add gravel to the shoulder as necessary to provide a safe surface, then install and backfill the pipe across half the roadway. In the second phase, traffic would be detoured to the opposite side of the road across the recently installed new pipe. The remaining half would then be excavated, installed and backfilled and the roadway surface restored. In cases of narrow county or private roads where two-stage construction is not practical, the road would be temporarily closed during construction, and traffic detoured to other roads. Detour plans would be submitted to appropriate county and state agencies for approval.

1.8.3.3.3 Stream Crossings. Pipeline crossings of streams would be designed to prevent damage to the pipe from high flows and to minimize environmental impacts. Design features would include encasing the pipeline in concrete or constructing a buried concrete barrier along the pipe under the channel. Stream channels that would be crossed by facilities included in the Proposed Action are relatively narrow and normally dry during the summer. Therefore, the contractor would be able to time stream crossings to minimize the risk of storm runoff and environmental impacts during installation. Most pipeline crossings could be installed and backfilled in less than a day.

1.8.3.3.4 Typical Noise Levels and Air Emissions. Table 1-8 and Table 1-9 in Section 1.8.2.3 define typical noise levels and air emissions that would be associated with constructing pipelines under the Proposed Action. The principal equipment needed to construct pipelines would include: dozers and graders for clearing ROW; water trucks for dust control throughout the construction period; backhoes, excavators and cranes for trench excavation and pipe placement; flatbed trucks for hauling pipe to the job site; dump trucks for hauling pipe bedding material; backhoes and compactors for backfilling the pipe trench; and loaders and graders for surface restoration.

Pumping stations, described in Section 1.8.4, would be the only long-term, noise-emitting feature of the Proposed Action. They would be enclosed in a pumphouse to minimize noise and the risk of vandalism.

1.8.4 Pumping Stations

1.8.4.1 Description of Facilities

The Proposed Action would include 10 pumping stations ranging from 25 hp to 685 hp, for a total of 2,200 hp. Three of the stations would be constructed along the Timpanogos Canal, four along the Daniel Replacement Pipeline, and three along the Wasatch Canal (see Map A-1 in pocket at back of EIS).

The pumping stations along the Timpanogos Canal would pressurize water for Timpanogos Irrigation Company parcels and would include a 15-hp station near Moulton Lane; a 30-hp station near the Winkler buffalo farm; and a 45-hp pumping station downstream of 950 North.

The largest pumping station, a 685-hp unit on the southern edge of the Timpanogos regulating pond, would serve the Daniel Replacement Pipeline and local distribution pipelines to the Timpanogos and Lake Creek irrigation companies. Two booster stations would serve the Daniel Replacement Pipeline: a 175-hp station a few hundred feet upstream of the 2400 East crossing would pump water through a pipeline with connections to the existing pipeline distribution system of the Center Creek Irrigation Company; and a 450-hp station at the crossing of Dukes Lane, just south of Center Creek Road, would pump water to the Middle Daniel Pond. A 50-hp pumping station also would be constructed near the southwest side of the pond to pump Daniel replacement water from the pond to a connection to the main pipeline of the Daniel Upper Pond distribution system.

Two of the three pumping stations along the Wasatch Canal would pressurize water for the Wasatch and Extension irrigation companies. A 75-hp station would be located at the Coyote Lane canal crossing and a 550-hp station would be located along the southern edge of the Wasatch regulating pond. The third station, a 125-hp unit at 950 North in the Valley Hills subdivision, would be reserved for use by Heber City to deliver non-culinary water (CUP M&I water and canal water) to Valley Hills subdivision for outdoor irrigation.

Figure 1-7 is a schematic of a typical pumping station, which has one to five vertical turbine pumps connected to a single discharge pipe. The pumps would be mounted on a concrete sump structure that draws water from a canal or pipeline. The typical 15-by-20-foot pump building would require a 30-by-50-foot ROW and house two pumps.

Powerlines would tie into each pump building and connect to electrical equipment that operates the motor. Most power poles would be about 30 feet tall, with shorter drop poles next to the pump house. Table 1-11 lists the pumping station power requirements, including pump sizes and power line extension lengths. The Proposed Action would require about 3.6 miles of power line extensions.

Approximately 30 privately owned pumps used for sprinkler irrigation would no longer be needed under the Proposed Action and would be removed by the owners pursuant to agreements between WCSSA No. 1 and the owners, along with associated electrical equipment. These units pump water from existing canals to the owners' on-farm sprinkler systems. Most are centrifugal pumps, averaging 20 hp each, that are removed from the canals and stored in buildings during the winter. Most of the area served by the existing pumps could be served by gravity pressure under the Proposed Action without the need for energy. The elevation difference between the fields and the delivery canal would be great enough to build the necessary pressure.

1.8.4.2 Construction Procedures

Pump building sump structures would be formed and poured in place. Backhoes, cranes, water trucks, pickups and compactors would use existing access roads or canal ROWs to access sites during construction.

1.8.5 Supplemental Instream Flows

Under the Proposed Action, five Heber Valley streams would receive supplemental instream flows, which would provide habitat for trout and other

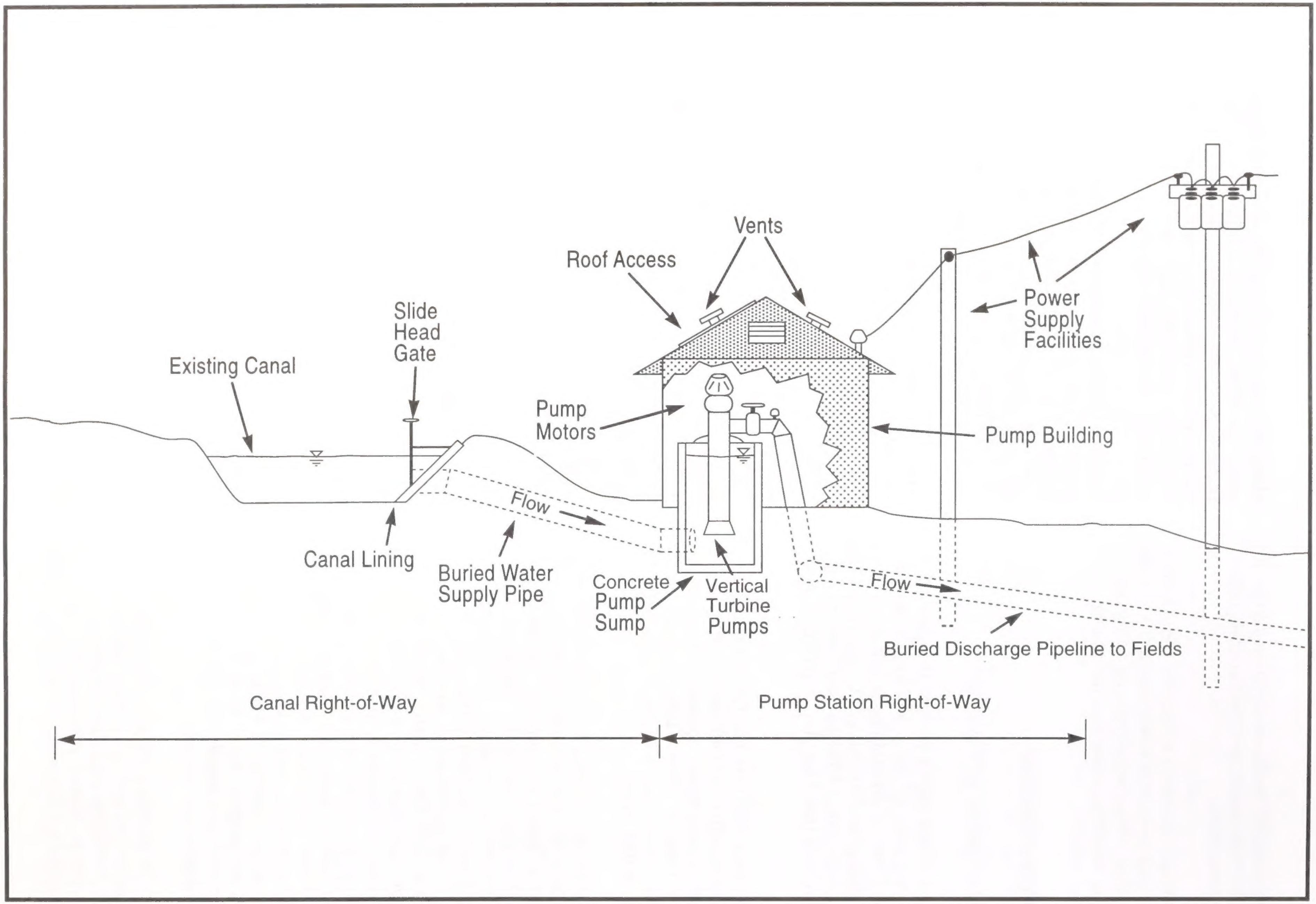


Figure 1-7
Schematic of Typical Pumping Station

Table 1-11
Pumping Station Power Requirements for the Proposed Action and DRP Alternatives

Pumping Station[a]	Serving Utility[b]	Powerline Extension Length (feet)	Service Connection Remarks	Pump Horsepower		
				Proposed Action (WCWEP With Daniel Replacement Pipeline)	DRP With Pipeline Alternative	DRP With Canal Alternative
DRP-1P	HL&P	1,000	Extend 3-phase line southeastward 1,000 feet from Mill Road	None	175	None
DRP-2P	HL&P	2,300	Extend 3-phase line southeastward from DRP-1P 2,300 feet	None	650	None
DRP-1C	HL&P	4,900	Extend 3-phase line eastward 4,900 feet from Mill Road	450	None	735
DRP-2C	HL&P	0	3-phase power at site	c	None	65
DRP-3	HL&P	600	Upgrade 3,400 feet of existing 2-phase line to 3-phase along Hwy 40 from Little Sweden Road and extend line eastward 600 feet from Hwy 40 to site	50	50	50
W1	HL&P	1,800	Extend line 1,500 feet eastward from Wasatch Canal or Hwy 40	75	0	0
W2	HL&P	0	3-phase power at site	125	0	0
W3	HL&P	0	3-phase power at site	550	0	0
T2	HL&P	0	Upgrade 2,400 feet of existing 2-phase line running eastward from Wasatch Canal to 3-phase	15	0	0
T3	HL&P	3,000	Extend line 3,000 feet eastward from Wasatch Canal or Hwy 40	30	0	0
T5	HL&P	3,200	Extend line 3,200 feet eastward from near corner of cemetery	45	0	0
T6	HL&P	1,875	Extend line northward 1,800 feet from 1200 South	685	0	0
T8	HL&P	3,800	Extend line southward 2,400 feet from 1200 South	175	0	0
Total Pumping Station Horsepower				2,200	875	850
Total Powerline Extension Length in Feet				19,175	3,900	5,500
Total Powerline Extension Length in Miles				3.6	0.7	1.0
Average Annual Energy Use				3,005,000 kwhr[d]	832,000 kwhr	802,000 kwhr
Average Annual Energy Use of Existing Pumps No Longer Needed with the WCWEP				1,110,000 kwhr	- - -	- - -
Net Increase in Average Annual Energy Use				1,895,000 kwhr[d]	832,000 kwhr	802,000 kwhr

Notes:

[a] Pumping station locations are shown on maps A-1 and A-2 in the map pocket at the back of the EIS.

[b] Serving utility is Heber Light & Power (HL&P).

[c] The DRP-2C pumping capacity of 80 hp is included in the T6 pumping station. The T6 pumping station includes 330-hp pumping capacity for conveying Daniel Replacement water.

[d] Includes energy for the Heber City Secondary System (See Section 3.1.2.2).

kwhr = kilowatt-hour

aquatic resources (see stream locations on Map A-1 in pocket at back of EIS). Table 1-12 lists the proposed target supplemental flows for each stream. No other aquatic habitat enhancement measures are included in the Proposed Action.

Supplemental instream flows are targets as opposed to mandatory, minimum-flow requirements. While sufficient water is expected to be available to meet the targets most of the time, the available supply would be limited to the amount of water conserved by the Proposed Action in any year minus the amount delivered to DIC (2,900 acre-feet annual average). Supplemental flow deficiencies of up to 35 percent would likely occur during dry years, which are expected approximately 5 percent of the time based on historic hydrology data used in the Draft Water Resources Technical Report (CUWCD 1996c). This report provides more information on the historic hydrology data used in this EIS and the amount of water that would be conserved by the Proposed Action.

The target supplemental instream flows were developed by the Instream Flow Work Group formed from members of the Fishery Technical Advisory Committee. The flows were developed by using input from interested agencies and the public, environmental rating criteria, field data and the Binns Habitat Quality Index (HQI) model. This model is described in the Draft Aquatic Resources Technical Report (CUWCD 1996a)

The instream flow reaches are presently used by local irrigation companies for water supply conveyance. Three flow control structures would be constructed to allow instream flows and fish to pass irrigation diversions. Two would be located on Rock Ditch, including one at the junction of Rock Ditch with Westside Ditch and the other at the junction of the turnout from Rock Ditch. The third flow control structure would be located on Spring Creek. Existing control structures at these locations are not adjustable, i.e., it is not possible to vary the flow into each channel. The new control structures would allow operators to adjust the flow into each channel.

Rock Ditch is a small irrigation ditch located along local ridges in some areas, with the ground sloping

Table 1-12
Target Supplemental Instream Flows Included in the Proposed Action

Stream	Reach[a]	Flushing Flow (cfs)	April 16th - October 15th (cfs)[b]	October 16th - April 15th (cfs)
Rock Ditch	RC-01	38	15	11
Spring Creek	SP-01 & SP-02	Natural	29	22
Spring Creek	SP-03	Natural	23	18
Lower Lake Creek	LC-01	Natural	6	4
London Ditch	SP-05	10	4[c]	Natural
Creamery Ditch	SP-04	10	6[c]	Natural

Notes:

[a] Reach numbers are representative reaches of the streams that would receive target supplemental instream flows.

[b] During dry years that occur approximately once every ten years, supplemental instream flows would be up to 35 percent less than the target supplemental instream flows during this period.

[c] These are target outflows at the confluence with Spring Creek and not target flows for the entire length of stream

away from the ditch. During severe cold weather,the upper reaches of the ditch could freeze solid, causing a blockage where water could overpour and flow across adjacent properties. Under such conditions, the flow throughout the ditch would be interrupted from a few hours to a few days to prevent property damage. Groundwater seepage draining into the lower reaches of Rock Ditch and Spring Creek would provide a base flow in these reaches until the blockage could be removed.

1.8.6 Operation and Maintenance

This section describes the water sources, diversions, conveyances and deliveries associated with the Proposed Action and other O&M procedures. CUP agricultural and M&I water would be distributed in the future in Heber Valley under baseline conditions. The Proposed Action would not deliver any new water, but would redistribute water in Heber Valley more efficiently to conserve water. Conserved CUP water would be used to meet the water requirements of the Daniel Replacement Pipeline. Non-CUP water that is conserved would be used to supplement the flows of Valley streams and maintain wetland areas. Conserved water that exceeds the target flows defined in Table 1-12 would be released to the Provo River from Jordanelle Reservoir or utilized by WCSSA for non-consumptive purposes.

WCSSA would be responsible for operating and maintaining the project under contract with CUWCD from a central office and maintenance yard at an undetermined location. The office would likely be staffed by an operations engineer-manager, clerical dispatcher, O&M supervisor and two or three part-time O&M personnel. The office would be equipped with a supervisory monitoring system capable of remotely monitoring the status of pumping stations and flows in the system at critical points. The control system would not include remote-control capability; but gate structures would be compatible with remote operation if such a system is used in the future. Flows in the streams that would receive supplemental instream flows would be monitored by WCSSA staff to help determine the appropriate timing for releases into the streams and to minimize the risk of flooding.

A dispatcher would receive phone orders, schedule water deliveries and monitor the system to determine that proper water volume always flows through the system. Operations personnel would receive radio directions from the dispatcher, open and close canal and pipeline turnout gates and adjust pumping station rates. The WCSSA operations staff would work closely with the Provo River Commissioner to divert each irrigation company's water according to their water rights. The WCSSA staff also would be responsible for distributing water after it is diverted from the Provo River and for distributing CUP water and providing goals for target supplemental instream flows.

O&M personnel would perform annual and routine maintenance during the non-irrigation season, including inspecting and lubricating pumping station equipment; inspecting, repairing and replacing flow meters as necessary; and inspecting canals and cleaning out debris before startup each spring. O&M personnel also would ensure that facilities are functioning properly during winter instream flow deliveries.

During the irrigation season, O&M personnel would inspect and clean canal turnout screens daily to avoid blockages in sprinkler lines; operate system gates and valves; monitor turnout flow meters; and investigate the cause of unexpected shutdowns at the pumping stations and manually restart the pumping units.

Table 1-13 lists the total water diversions and deliveries under the Proposed Action and DRP alternatives on an average annual basis. A 4 percent transmission loss has been deducted from CUP water delivered from Jordanelle. The Proposed Action would divert an average of 57,240 acre-feet per year from the Provo River. It would deliver an average of approximately 25,860 acre-feet per year of non-CUP agricultural water, 2,480 acre-feet per year of water to maintain shallow groundwater levels in the North Fields area, 12,130 acre-feet of CUP water, 2,900 acre-feet per year of conserved water for Daniel Replacement and 10,210 acre-feet per year of water to supplement local stream flows. Conveyance losses (water that seeps out of a canal) would total about 3,660 acre-feet per year. WCSSA would be responsible for delivering water after it is diverted from the river under the direction of the River Commissioner appointed by the State Engineer. Additional information on water deliveries and a schematic routing diagram is included in the Draft Water Resources Technical Report (CUWCD 1996c) (see Section 4.3.1).

The following subsections provide additional information about diversions, conveyances and deliveries for each major conveyance facility under the Proposed Action.

1.8.6.1 Timpanogos Canal and Daniel Replacement Pipeline

The Timpanogos Canal would convey irrigation water to portions of the Timpanogos, Lake Creek, Center Creek and Wasatch irrigation companies and the Daniel replacement water to DIC. It would not deliver water to streams enhanced under the Proposed Action.

An average of 11,660 acre-feet of water per year would be diverted into the Timpanogos Canal from the Provo River at the new diversion structure. The Daniel replacement supply would be conveyed through the Timpanogos Canal and would average 2,900 acre-feet per year. The maximum diversion rate would be about 72 cfs. An average of 7,300 acre-feet per year would be delivered from this system to farms in the Timpanogos, Wasatch, Lake Creek and Center Creek irrigation companies. Water would be delivered to users at a maximum rate of 8.4 gallons per minute per acre for sprinkler irrigation.

Water would be pumped to the Daniel Middle Pond at a maximum rate of 21 cfs and to the Daniel Lower Pond at a maximum rate of 7 cfs. The combined delivery rate to both ponds would not exceed 27 cfs. Water would be pumped from the middle pond to a connection with the Daniel Upper Pond pipeline at a maximum rate of 5.7 cfs. The DIC would convey the replacement water from the ponds to farmers for irrigation through existing delivery pipelines.

The Timpanogos Canal and the Daniel Replacement Pipeline would deliver water during the normal irrigation season, typically April 15 to October 15. The facilities would be dewatered during the winter season after stock water is delivered, as late as mid-November.

1.8.6.2 Wasatch and Humbug Canals

The Wasatch and Humbug canals would deliver water to remaining portions of the Timpanogos and Wasatch irrigation companies not served by the Timpanogos Canal. They also would convey water to the Extension Irrigation Company and portions of Spring Creek, Sage Brush, Charleston (Upper and Lower Canals) irrigation companies that are part of the WCWEP service area. The Provo River water supply of the latter companies above presently flows through and helps irrigate the North Fields area on its way to Spring Creek. Water routed through the Wasatch Canal and distributed by pipeline would not be available to the North Fields Irrigation Company. The Wasatch Canal would be used to convey water to supplement instream flows of London Ditch, Creamery Ditch, Rock Ditch, Lower Lake Creek and Spring Creek. Water for the North Fields Irrigation Company would be conveyed through the initial 2,000 feet of the Wasatch Canal to the Rock Ditch and MacDonald Ditch turnouts.

Table 1-13 shows that an average of 45,580 acre-feet per year would be diverted into the Wasatch Canal from the Provo River at the Wasatch Diversion. After flowing through the Wasatch Canal, water would enter the Humbug Canal, which is a southern extension of the Wasatch Canal.

An average of about 43,380 acre-feet per year would be delivered from the canal. Irrigation companies that are participants of the WCWEP would receive an average of 16,360 acre-feet per year of non-CUP and CUP water. The North Fields Irrigation Company, which would not participate in the WCWEP, would receive 16,810 acre-feet per year. This includes about 2,480 acre-feet of conserved water per year to maintain wetland areas that would otherwise be impacted by rerouting a portion of the Charleston, Sage Brush and Spring Creek irrigation company's water supply through the Wasatch Canal.

Approximately 10,210 acre-feet per year would be delivered to London Ditch, Creamery Ditch, Rock Ditch, Lower Lake Creek and Spring Creek to maintain instream flows described in Section 1.8.5. The Wasatch Canal would include 12.0 cfs of

Table 1-13
Water Diversions and Deliveries Under the Proposed Action and DRP Alternatives
(Acre-feet per year on an average basis)

Proposed Action (Wasatch County Water Efficiency Project With Daniel Replacement Pipeline)

	Diversions								Deliveries							
	Non-CUP Agricultural	**Non-CUP Wetland Maintenance**	**CUP Agricultural**	**CUP M&I**	**DRP**	**Conserved Water**	**Provo River By-pass Flow**	**Total**	**Non-CUP Agricultural**	**Non-CUP Wetland Maintenance**	**CUP Agricultural**	**CUP M&I**	**DRP**	**Conserved Water**	**Provo River By-pass Flow**	**Total**
Timpanogos Canal																
Timpanogos Irrigation Company	2,490	0	2,700	0	0	0	0	5,190	2,120	0	2,300	0	0	0	0	4,420
Wasatch Irrigation Company (Rural)	1,230	0	30	0	0	0	0	1,260	1,050	0	30	0	0	0	0	1,080
Lake Creek Irrigation Company	0	0	1,260	0	0	0	0	1,260	0	0	1,260	0	0	0	0	1,260
Center Creek Irrigation Company	0	0	540	0	0	0	0	540	0	0	540	0	0	0	0	540
Daniel Replacement Supply	510	0	0	0	2900	0	0	3,410	0	0	0	0	2,900	0	0	2,900
Total Timpanogos Canal	4,230	0	4,530	0	2,900	0	0	11,660	3,170	0	4,130	0	2,900	0	0	10,200
Wasatch Canal																
Timpanogos Irrigation Company	170	0	180	0	0	0	0	350	150	0	160	0	0	0	0	310
Wasatch Irrigation Co. (Rural)	6,290	0	170	0	0	0	0	6,460	5,660	0	150	0	0	0	0	5,810
Wasatch Irrigation Co. (Heber City)	2,020	0	0	2,400	0	0	0	4,420	1,820	0	0	2,160	0	0	0	3,980
Extension Irrigation Company	670	0	570	0	0	0	0	1,240	600	0	510	0	0	0	0	1,110
North Fields Irrigation Company	9,430	2,480	4,900	0	0	0	0	16,810	9,430	2,480	4,900	0	0	0	0	16,810
Spring Creek Irrigation Company	1,720	0	10	0	0	0	0	1,730	1,550	0	10	0	0	0	0	1,560
Sagebrush Irrigation Company	1,480	0	120	0	0	0	0	1,600	1,340	0	100	0	0	0	0	1,440
Charleston Irrigation Co. (Upper Canal)	2,120	0	10	0	0	0	0	2,130	1,900	0	10	0	0	0	0	1,910
Charleston Irrigation Co. (Lower Canal)	270	0	0	0	0	0	0	270	240	0	0	0	0	0	0	240
Rock Ditch Supplemental Flow	0	0	0	0	0	2,510	6,900	9,410	0	0	0	0	0	2,510	6,900	9,410
London Ditch Supplemental Flow	0	0	0	0	0	570	0	570	0	0	0	0	0	390	0	390
Creamery Ditch Supplemental Flow	0	0	0	0	0	590	0	590	0	0	0	0	0	410	0	410
Lower Lake Supplemental Flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wasatch Canal	24,170	2,480	5,960	2,400	0	3,670	6,900	45,580	22,690	2,480	5,840	2,160	0	3,310	6,900	43,380
Total Proposed Action	28,400	2,480	10,490	2,400	2,900	3,670	6,900	57,240	25,860	2,480	9,970	2,160	2,900	3,310	6,900	53,580

Daniel Replacement Project With Pipeline Alternative

	Diversions								Deliveries							
	Non-CUP Agricultural	Non-CUP for Wetland Maintenance	CUP Agricultural	CUP M&I	DRP	In-Stream Supplemental Flow	Provo River By-pass Flow	Total	Non-CUP Agricultural	Non-CUP Wetland Maintenance	CUP Agricultural	CUP M&I	DRP	Conserved Water	Provo River By-pass Flow	Total
Daniel Replacement Pipeline																
Daniel Replacement Supply	0	--	--	--	2,900	--	0	2,900	0	---	---	---	2,900	---	0	2,900
Total Daniel Replacement Project With Pipeline Alternative	0	--	--	--	2,900	--	0	2,900	0	---	---	---	2,900	---	0	2,900

Daniel Replacement Project With Canal Alternative

	Diversions								Deliveries							
	Non-CUP Agricultural	Non-CUP Wetland Maintenance	CUP Agricultural	CUP M&I	DRP	Conserved Water	Provo River By-pass Flow	Total	Non-CUP Agricultural	Non-CUP Wetland Maintenance	CUP Agricultural	CUP M&I	DRP	Conserved Water	Provo River By-pass Flow	Total
Timpanogos Canal																
Timpanogos Irrigation Company	9,630	--	2,080	0	0	--	0	11,710	8,190	--	1,770	0	0	--	0	9,960
Lake Creek Irrigation Company	0	--	890	0	0	--	0	890	0	--	890	0	0	--	0	890
Center Creek Irrigation Company	0	--	390	0	0	--	0	390	0	--	390	0	0	--	0	390
Daniel Replacement Supply	0	--	0	0	3,410	--	0	3,410	0	--	0	0	2,900	--	0	2,900
Total Timpanogos Canal	9,630	--	3,360	0	3,410	--	0	16,400	8,190	--	3,050	0	2,900	--	0	14,140
Total Daniel Replacement Project With Canal Alternative	9,630	--	3,360	0	3,410	--	0	16,400	8,190	--	3,050	0	2,900	--	0	14,140

capacity for supplemental instream flows in the summer to London and Creamery ditches and 20 cfs of capacity for year-round supplemental instream flow to the Rock Ditch/Spring Creek/Lake Creek system. The Wasatch Canal would deliver an average of 1,820 acre-feet per year of Wasatch Irrigation Company water to company stockholders with land in Heber City.

Heber City has requested four delivery points from the Wasatch Canal system to convert the existing ditch conveyance system in the city to a pressure pipeline system, known as the Heber City Secondary System (HCSS) (see Section 3.1.2.2). The Proposed Action facilities would have the capacity to meet the delivery and pressure needs of the outdoor watering system that would be developed by Heber City. The water supply for the HCSS would be non-CUP water owned by individuals in Heber City. The Proposed Action would continue to deliver water to Heber City by releasing water from the Wasatch Canal into existing ditches until the city converts to a pipeline system.

WCSSA would contract for CUP M&I water in Heber Valley and subcontract with local entities. The 2,400 acre-feet of available M&I supply would likely be conveyed through the Wasatch Canal to the Center Street area under baseline conditions and distributed to M&I water users from that location including M&I water users on the west side of the river. The Proposed Action would not change the quantity or conveyance of CUP M&I water. Approximately 10 percent of the CUP M&I water would be lost to seepage in the Wasatch Canal, resulting in an average delivery of 2,160 acre-feet.

The initial 2,000 feet of the Wasatch Canal from the Wasatch Diversion to the Rock Ditch turnout would be operated year-round to maintain an instream flow in Rock Ditch. The Humbug and Wasatch canals below the Rock Ditch turnout would be dewatered after mid-November, after the irrigation season and when stockwater is not conveyed in the canals.

1.8.6.3 Sagebrush and Spring Creek Canal

The Sagebrush and Spring Creek Canal would convey water from Spring Creek to the reach of Lake Creek downstream of Heber City, which would establish and maintain a year-round flow in lower Lake Creek. The Proposed Action would use the initial 9,200 feet of the Sagebrush and Spring Creek Canal through a wheeling agreement with the owners of the canal. Water would be diverted from Spring Creek and released into lower Lake Creek to maintain a flow of 6 cfs instream flow in summer and 4 cfs in winter.

1.8.7 Abandonment and Removal of the Upper Strawberry River Diversion Facilities

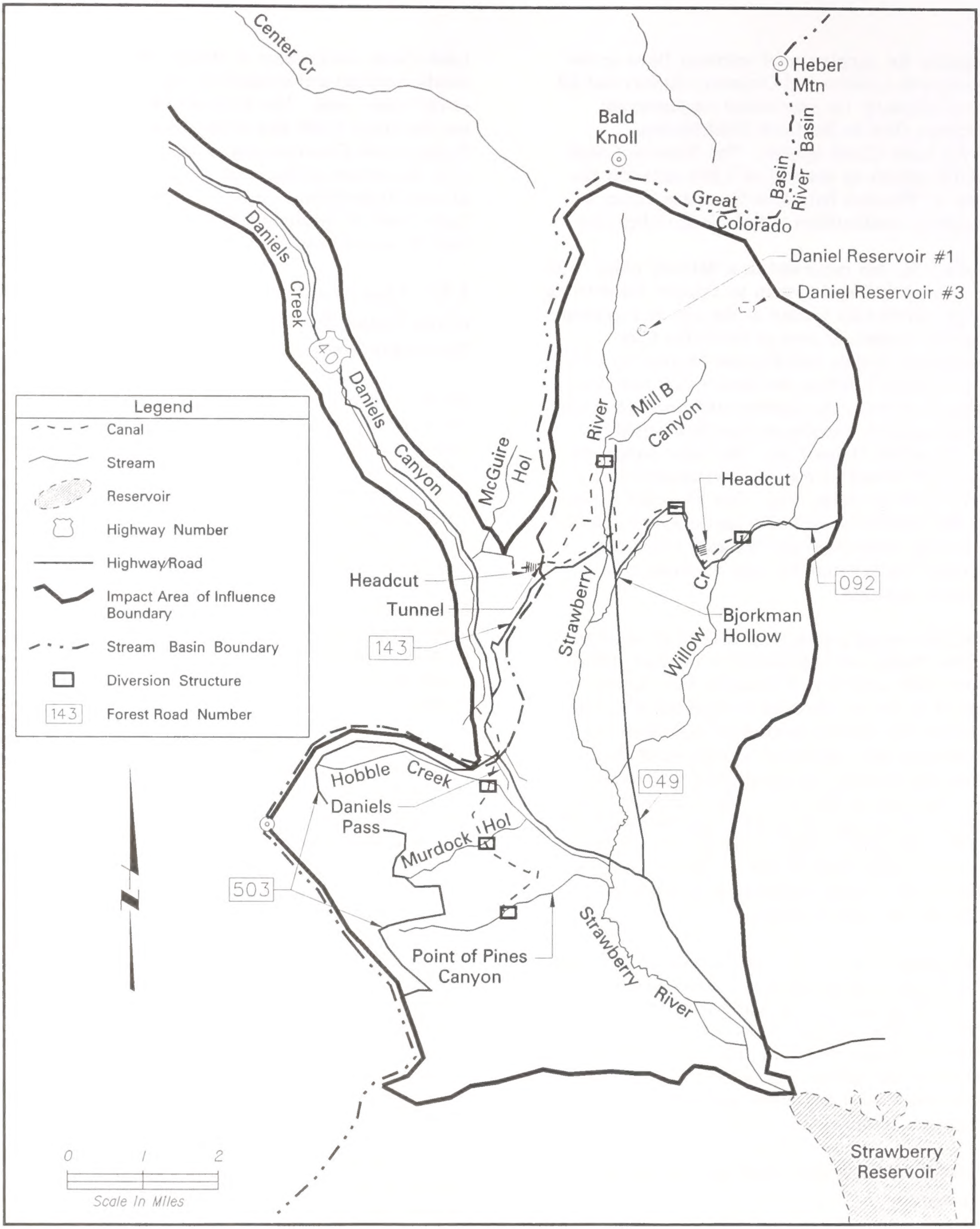
The DIC diversion facilities in the upper Strawberry River basin would be abandoned and removed under the WCWEP and DRP alternatives. These facilities, on National Forest System land administered by the Uinta National Forest, would be abandoned and removed by the U.S. Forest Service after the DIC's transbasin diversions to Daniels Creek are terminated.

Map 1-4 shows DIC diversion facilities in the upper Strawberry River basin. The following streams are diverted under baseline conditions and would no longer be diverted under the Proposed Action:

- The stream in Point of Pines Canyon
- The stream in Murdock Hollow
- Hobble Creek near Daniels Pass Divide
- Willow Creek
- The stream in Bjorkman Hollow
- The upper Strawberry River

Abandonment and removal of the DIC diversion facilities would include modifications to existing canals, diversion structures, reservoirs, a tunnel and siphon, stream gauges and roads. Two existing headcuts also would be stabilized. These modifications, which are described in the following subsections, would occur within the impact area of influence boundary shown on Map 1-4.

The U.S. Forest Service (USFS) developed the abandonment and removal plan by soliciting input from the public and other agencies, outlining related issues, and identifying alternative actions. An interdisciplinary team evaluated the issues and alternatives and rated them to select the proposed plan defined in the following subsections.



Map 1–4
Daniel Irrigation Company
Diversion Facilities in the Upper Strawberry River Basin

1.8.7.1 Tunnel Modifications

The east side of the McGuire Tunnel (the tunnel between the Daniels Creek and Strawberry River watersheds) would be plugged with concrete. The west end of the tunnel would be plugged with concrete just inside the tunnel, then the end would be collapsed and buried to avoid public safety hazards. The inlet structure, water gauge, overflow, debris gate and a portion of the concrete canal would be retained for historical interpretation.

1.8.7.2 Siphon Modifications

The concrete structures of the siphon's inlet would be left for historical interpretation. The pipe would be plugged, a new drain outlet installed and a grate put over the collection box to avoid public safety hazards. The drain located near the Strawberry River would be removed and the pipe plugged with concrete. The concrete outlet structure on the west side of the Strawberry River would be removed and the pipe plugged with concrete. The drain and outlet pipe then would be buried, and the disturbed area would be reshaped to more natural slopes, then fertilized, mulched and seeded to stabilize the site and promote desirable plant species.

1.8.7.3 Canal Modifications

The canals would be modified by removing their banks where they cross natural drainages and filling in both ends of canal segments with dirt to prevent water from entering the canal system. These modified areas then would be recontoured and revegetated. The Willow Creek-Bjorkman Canal would be removed and revegetated in areas where it crosses steep slopes or soil types that erode easily.

1.8.7.4 Diversion Structure Modifications

The concrete portion of the Strawberry Diversion structure would be altered to allow fish migration, but would be retained for historical interpretation. This would be done by removing the east half of the concrete diversion, leaving only the center headgate, west abutment and connecting concrete base. The wood walkway would be removed for public safety reasons. The dike that runs east from the diversion to the inlet would be eliminated by moving the dirt to match existing slopes of the area. The concrete inlet structure for the canalalso would be removed. The other 12 concrete diversions and associated structures would be removed and the surrounding canals reshaped to the natural slope of the surrounding areas. These disturbed sites then would be fertilized, mulched and seeded.

1.8.7.5 Dam Modifications

The Daniel No. 1 and No. 3 dams would be breached according to Utah State Engineer standards and stabilized at a level low enough to protect public safety while creating approximately 4.3 acres of wetlands upstream of the dams. Settled soils from the perimeter of each reservoir bottom would be collected, moved to one side and stockpiled. The dams would be replaced by a long, gentle slope with the drainage restored to its natural location. Stockpiled soil from the reservoir bottoms would then be spread over the new slope and the area fertilized, mulched and seeded. The wetland areas up-gradient of the long slope then would be revegetated with native wetland plant species.

1.8.7.6 Stream Gauge Modifications

The stream gauge east of the McGuire Tunnel would be left intact for historical interpretation. The other three stream gauges would be removed, and disturbed areas would be restored to natural contours, then fertilized, mulched and seeded.

1.8.7.7 Headcut Stabilization

Two existing headcuts (severe erosion from water flowing over soils on steep slopes) would be stabilized. The Bjorkman headcut would be stabilized by first removing the topsoil and storing it nearby. The sides of the headcut then would be reshaped to a more gentle slope. The canal would be pushed in and sloped for approximately 100 feet so it would not deliver water to the Bjorkman drainage. The topsoil then would be spread over the gentle slopes and the area revegetated. After the McGuire Tunnel is closed, the McGuire headcut would be stabilized by first stockpiling topsoil, then reshaping the side slopes to be more gentle and natural. The topsoil would then be spread over the new slopes then fertilized, mulched and seeded. A temporary fence would be constructed around the headcut to protect the area until the vegetation is established. Shallow terraces would be constructed across filled areas to prevent erosion. Small check dams would be placed in the bottom of the newly formed drainages to slow the velocity of runoff water and help stabilize the headcuts. Work on both headcuts would disturb about 1 acre.

1.8.7.8 Road Closures and Revegetation

Roads associated with the DIC diversion facilities would be closed. Construction crews would rip and revegetate roads leading to the dams and the two-wheel track roads used for canal maintenance, and install signs reading "Closed to Motorized Vehicles" in appropriate locations. The roads to the dams would be reshaped to natural slopes in certain areas to provide drainage and to discourage use by unauthorized vehicles.

1.8.7.9 Pipeline Construction and Livestock Watering

A pipeline would be constructed to convey water to six watering troughs for livestock that currently use the canal system as a source of drinking water. The troughs also would help protect riparian habitat along the Strawberry River by providing an alternative watering source. The water source for the troughs would be a spring. Two pipes would convey water along the existing road to the corral area. From the corral area, one pipeline would convey water along the east side of the Strawberry River through the abandoned canal to two troughs. The other pipeline would cross the Strawberry River just below the existing bridge, and continue onto a bench west of the Strawberry River. This pipeline would follow the bench south until it reaches the abandoned canal and then would follow the canal alignment. It would travel west and terminate at the head of McGuire Hollow. There would be four troughs along this pipeline. The trough at the head of McGuire Hollow would be constructed to provide water for livestock in the east Daniels Creek Allotment. The Forest Service or permittees would install the pipelines.

The spring, located on a small bench (about 150 feet wide) east of the Mill B Corral, has been developed to provide water for the herder and his riding stock. The existing headbox puts water into a pipe that runs about 50 feet to a storage tank in front of the herder's cabin. The overflow water and water not caught by the headbox continues down a slope of about 30 percent for about 200 feet, where it joins Shingle Mill Creek. The riparian area associated with this spring is located on the steep slope, is very narrow and mixed with the rocks and snowberry. The proposed pipeline would enlarge the storage tank and deliver water from the tank to troughs on both sides of the Strawberry River. The water not captured at the headbox and water from the overflow would continue to flow down the natural channel to Shingle Mill Creek. The diversion of water to the troughs would be seasonal and vary from year to year. It is not anticipated that this project would diminish existing wetlands.

When the canals are dewatered, wildlife and livestock will need to travel further for water because of the lack of natural water in the area of the canals. Several alternatives were considered to mitigate this loss. One was to put a diversion or collection system in the Strawberry River, which would disturb the river during construction and probably every year for maintenance. This alternative would also require installing a hydraulic pump or finding a location another mile upriver to gain enough elevation to transport water to the bench west of the Strawberry River. The spring was selected because it is already developed, would require relatively minimal maintenance, and the elevation allows water to flow to the bench west of the river.

1.9 Daniel Replacement Project With Pipeline Alternative — Physical Features and Other Characteristics

The DRP With Pipeline Alternative would use a pipeline to convey water to DIC from the Provo River immediately below Jordanelle Reservoir. The water conveyed by the pipeline would replace water presently diverted from the upper Strawberry River basin to the Daniels Creek drainage. There would be no water efficiency improvements or supplemental flows under this alternative. This alternative would not include any canals, regulating ponds or O&M roads. DIC diversion facilities in the upper Strawberry River basin would be abandoned and removed. Unlike the Proposed Action, this alternative would not conserve water by making possible the conversion of flood irrigation to sprinklers in Heber Valley. The following sections provide additional information concerning this alternative.

The DRP With Pipeline Alternative would be funded by the Mitigation Commission and local funding sources, and constructed, operated and maintained by CUWCD. The federal government would hold title to the facilities and ROWs, and the Mitigation Commission would pay for operation, maintenance and replacement.

The Mitigation Commission would acquire and pay for 2,900 acre-feet per year of storage water from Jordanelle Reservoir that would be reallocated from CUP agricultural water to fish and wildlife purposes. Reallocation of this supply would reduce the CUP agricultural supply available for contracting to Heber Valley from an annual average of 12,100 acre-feet to 9,200 acre-feet per year.

1.9.1 Changes in Water Use and Irrigation Companies

DIC is the only irrigation company that would be served by this alternative (see location on Map 1-3, Section 1.8.1). The DRP With Pipeline Alternative would deliver water to DIC's existing regulating ponds, which serve about 1,730 irrigated acres of farmed land. Section 3.2 in Chapter 3 describes potential changes in water availability on these lands.

1.9.2 Pipeline Conveyance Facilities

Map A-2 (see pocket at back of EIS) shows pipeline locations under this alternative. The Daniel replacement pipeline would consist of about 10 miles of 36-inch-diameter pipe and about 2 miles of smaller pipe, ranging from 12 to 27 inches in diameter (see Table 1-10 in Section 1.8.3). The Timpanogos Diversion structure would be reconstructed as described in Section 1.8.2.1.1 to accommodate diversion of water into the pipeline. Figure 1-2 in Section 1.8.2.1.1 shows a site plan and cross-section for reconstruction of the Timpanogos Diversion.

Static pressure in the pipeline would be zero near the Provo River diversion site, and increase to a maximum of 128 pounds psi 0.75 of a mile northeast of Heber City. From this point south, maximum pressure would decrease to less than 25 psi near the pipeline branch near Highway 40. Maximum pipeline pressure in branch laterals would be about 100 psi immediately after the pumping stations and decrease to less than 5 psi near delivery locations. The pipeline would include shutoff valves that could be closed to stop the flow during an emergency. No pressure reducers would be required for this system.

Table 1-7 in Section 1.8.2.2 shows the ROWs required for the DRP With Pipeline Alternative. The federal government would purchase about 56 acres of permanent ROWs, and another 40 acres of temporary easement would be needed for construction. Surface use of the pipeline ROW would be licensed back to the previous owner for uses such as agriculture that would not interfere with operation or maintenance of the pipeline.

The pipeline facility construction procedures would be the same as described for the pipelines included in the Proposed Action (see Section 1.8.3.3). One contractor construction yard would be constructed. The location has not been determined, but would be close to the pipeline alignment, with good paved access to major roadways.

1.9.3 Pumping Stations

This alternative would include construction of three pumping stations with a total capacity of 875 hp (see Map A-2 in pocket at back of EIS). Table 1-11 in Section 1.8.4.1 shows the pumping stations would be 175, 650 and 50 hp. The pumping stations would be enclosed in buildings as shown in Figure 1-7 in Section 1.8.4.1. Construction procedures would be the same as described for the Proposed Action in Section 1.8.4.2.

1.9.4 Operation and Maintenance

Table 1-13 in Section 1.8.6 shows water diversions and deliveries to the DIC averaging 2,900 acre-feet per year. Daniel replacement supply would come from CUP agricultural water in Jordanelle Reservoir. The Daniel Replacement Pipeline would be operated by the CUWCD in conjunction with Jordanelle Reservoir operations, rather than WCSSA. The pipeline would normally be operated from June through September when the natural supply of Daniels Creek is insufficient to meet irrigation needs. The maximum delivery rate to DIC would be 27 cfs. Delivery rates to the DIC ponds would be the same as the Proposed Action described in Section 1.8.6.

1.9.5 Abandonment and Removal of the Upper Strawberry River Diversion Facilities

The DIC diversion facilities in the upper Strawberry River basin would be abandoned and removed under the DRP With Pipeline Alternative, as described in Section 1.8.7.

1.10 Daniel Replacement Project With Canal Alternative — Physical Features and Other Characteristics

The DRP With Canal Alternative would use a pipeline and enlarged Timpanogos Canal to convey water to DIC from the Provo River immediately below Jordanelle Reservoir. Water conveyed by the pipeline and canal would replace water presently diverted from the upper Strawberry River basin to the Daniels Creek drainage. The DIC diversion facilities in the upper Strawberry River basin would be abandoned and removed under this alternative. Unlike the Proposed Action, this alternative would not conserve water by making possible conversion of flood irrigation to sprinklers in Heber Valley. The following sections provide additional information concerning this alternative.

The DRP With Canal Alternative would be funded by the Mitigation Commission and local funding sources, and constructed, operated and maintained by CUWCD. The federal government would hold title to the facilities and ROWs, and the Mitigation Commission would pay for operation, maintenance and replacement.

The Mitigation Commission would acquire and pay for 3,410 ac-ft per year of storage water from Jordanelle Reservoir that would be reallocated from CUP agricultural water to fish and wildlife purposes. Reallocation of this supply would reduce the CUP agricultural supply available for contracting to Heber Valley from an annual average of 12,100 ac-ft to 8,690 ac-ft per year.

1.10.1 Changes in Water Use and Irrigation Companies

This alternative would provide the same replacement supply quantities to DIC as the DRP With Pipeline Alternative (Section 1.9.1). DIC Water supply availability also would change, as with the Proposed Action and the DRP With Pipeline Alternative.

1.10.2 Canal Conveyance Facilities, Regulating Ponds and Roads

1.10.2.1 Description of Facilities

About 9 miles of the existing Timpanogos Canal would be enlarged to convey Daniel replacement water under this alternative. The enlargement would vary from 33 cfs in the northern segment to 8 cfs in the southern. Emergency spillways would be added to the canal at Lake Creek and Center Creek crossings. Canal road crossings and delivery facilities would be replaced and enlarged as necessary to convey the project flow. No regulating ponds would be constructed.

The Timpanogos Diversion structure would be reconstructed as described in Section 1.8.2.1.1. Figure 1-2 in Section 1.8.2.1.1 shows a site plan and cross-section for reconstruction of the Timpanogos Diversion.

Figure 1-1 in Section 1.8.2 includes a schematic of a typical enlarged canal. Table 1-6 in Section 1.8.2.1 lists the location of the canal enlargement and concrete lining. Map A-2 in the pocket at the back of the EIS shows the stationing of the concrete lining. The enlargement would extend from a few hundred feet below the Highway 32 crossing to the crossing of Spring Ditch. North of Spring Ditch, 4-inch concrete lining would be installed on the inside face of the enlarged Timpanogos Canal. The canal would be cleaned and reshaped before installing the lining, but the existing canal bottom elevation and canal width would not change. The reshaped canal cross-section would be more hydraulically efficient. Based on preliminary evaluations, the water depth in the canal would increase by about 6-12 inches, depending on location. In certain short reaches the canal embankment on the side with concrete lining would be raised by as much as 6 inches.

South of Spring Ditch, the Timpanogos Canal would be enlarged by excavating about 1.5 feet below its current level. On the west side of the canal, excavated material would be used to build an O&M road about 15 feet wide and 1 foot above the original ground elevation. The road would extend about 2.8 miles from the Spring Ditch crossing (Station 49,002) to the crossing of Mill Road (Station 63,620). The road would have a gravel surface and would be restricted to CUWCD operations personnel and their agents and adjacent property owners for access to their fields.

Table 1-7 in Section 1.8.2.2 shows the canal ROWs that would be acquired. Permanent ROWs, ranging from 55 to 95 feet wide depending on the width of existing canal embankments, would be purchased by the federal government in fee title. A temporary accessway 30 feet wide would be acquired along the canal reach with an O&M road to provide additional work area during construction. Additional temporary access roads would be acquired for construction access at approximately 2,000-foot intervals along the reach of canal to be lined.

1.10.2.2 Construction Procedures

Construction equipment would be operated from the bottom of the Timpanogos Canal north of Lake Creek. Crews would clear and clean the inside of the canal, excavate existing material and place the concrete lining. Trees and shrubs outside of the canal would remain undisturbed unless overhanging branches would create an operational hazard.

South of Lake Creek, the Timpanogos Canal passes through grassy farm areas and is not lined with trees. Scrapers would be used for earthwork operations and to build O&M roads. The construction area of disturbance would include the temporary access roads, and disturbed areas would be restored and revegetated following construction.

1.10.3 Pipeline Conveyance Facilities

1.10.3.1 Description of Facilities

A 36-inch steel, mortar-lined and coated pipeline would provide a maximum flow rate of 33 cfs for the initial 2.8 miles of water conveyance under this alternative (see Table 1-10 in Section 1.8.3). The initial reach of pipeline would have 6 cfs greater capacity than the pipeline in the DRP With Pipeline Alternative to allow for conveyance losses in the Timpanogos Canal. It would generally follow the same alignment as the DRP With Pipeline Alternative and discharge into the Timpanogos Canal just below the Highway 32 crossing. Two pumping stations and smaller pipelines would then convey water from the enlarged Timpanogos Canal to existing DIC facilities.

Two pipelines would convey water from the Timpanogos Canal near the end of the reach that would be enlarged under this alternative. The first pipeline would consist of approximately 8,000 feet of 30-inch steel, mortar-lined and coated pipe to convey water at a maximum flow rate of 21 cfs from the Timpanogos Canal to the Daniel Middle Pond. About 500 feet of 12-inch PVC pipe would then convey water at a maximum rate of 5.7 cfs from the Daniel Middle Pond to the existing pipeline delivering water from the Daniel Upper Pond. The second pipeline would consist of about 4,616 feet of 16-inch PVC pipe to convey water at a maximum rate of 7 cfs from the enlarged Timpanogos Canal to the Daniel Lower Pond. Table 1-10 in Section 1.8.3 shows the pipeline lengths for this alternative. The two pipelines would have a maximum simultaneous delivery of 27 cfs.

1.10.3.2 Construction Procedures

Pipeline construction procedures would be the same in Section 1.8.3.3.

1.10.4 Pumping Stations

1.10.4.1 Description of Facilities

Map A-2 (see pocket at back of EIS) shows the locations of three pumping stations that would be constructed with a total capacity of 850 hp.

Table 1-11 in Section 1.8.4.1 lists capacities of individual pumps, which would be enclosed in pump buildings. Figure 1-7 in Section 1.8.4.1 is a schematic of a typical pumping station.

1.10.4.2 Construction Procedures

Pumping station construction procedures would be the same as in Section 1.8.4.2.

1.10.5 Operation and Maintenance

About 3,410 acre-feet per year of replacement water would be diverted from the Provo River at the Timpanogos Canal diversion, as shown in Table 1-13 in Section 1.8.6. About 15 percent of the replacement water would be lost to seepage from the Timpanogos Canal, resulting in an average delivery to the DIC of 2,900 acre-feet per year, the same amount as in the Proposed Action and the Daniel Replacement Project with Pipeline Alternative.

The CUWCD would operate and maintain the Timpanogos Canal under this alternative. It would be responsible for maintaining water conveyances and turnouts of irrigation companies that use the canal under baseline conditions. As shown in Table 1-13 in Section 1.8.6, the CUWCD would be required to maintain the diversion and conveyance of approximately 11,700 acre-feet of water per year for the Timpanogos Irrigation Company. The CUWCD would be responsible for diverting and conveying an estimated 1,280 acre-feet per year of CUP water that would likely be wheeled through the Timpanogos Canal by the Lake Creek and Center Creek irrigation companies after CUP deliveries from Jordanelle Reservoir begin.

The canal, pipeline and pumping station O&M procedures would be the same as in Section 1.8.6.

1.10.6 Abandonment and Removal of the Upper Strawberry River Diversion Facilities

The DIC diversion facilities in the upper Strawberry River basin would be abandoned and removed under the DRP With Canal Alternative, as described in Section 1.8.7.

1.11 The No Action Alternative

The No Action Alternative is the alternative of not implementing the Proposed Action or DRP alternatives. The No Action Alternative would result in no changes in the following:

- Water efficiency in Heber Valley
- Instream flows in Heber Valley streams
- Capacity of the Timpanogos, Wasatch and Humbug canals
- Operation of Heber Valley canals and ditches
- Operation of DIC diversion facilities in the upper Strawberry River basin
- Transbasin diversions from the upper Strawberry River basin to Daniels Creek
- DIC diversions from Daniels Creek
- The Mitigation Commission would alter or reconstruct any existing river diversion facilities located between Jordanelle and Deer Creek reservoirs that are incapable of allowing a minimum of 125 cfs to pass at all times.
- Flows in the upper Strawberry River basin.

The needs defined in Section 1.2 would not be met and baseline conditions would continue.

The following commitments included in the M&I System EISs related to Jordanelle Reservoir (USBR 1979 and USBR 1987) would still be implemented under baseline conditions and their related effects would continue under the No Action Alternative.

- CUWCD would maintain a minimum streamflow of 125 cfs in the Provo River between Jordanelle and Deer Creek reservoirs

- Any existing river diversion facilities located between Jordanelle and Deer Creek reservoirs that are incapable of allowing a minimum of 125 cfs to pass at all times would be reconstructed to function properly under baseline. Any changes to river diversion facilities beyond those that would be made under baseline are described as part of the Proposed Action and alternatives.

- The Mitigation Commission would construct seven new fishing access points along the Provo River between Jordanelle and Deer Creek reservoirs, acquire and fence land along the Provo River to provide contiguous fishing access (by foot only), and construct parking areas and sanitary facilities

- CUWCD would deliver supplemental CUP water to water users in Heber Valley and below Deer Creek Reservoir as Jordanelle Reservoir goes into operation

The impacts of the commitments listed above were documented in the M&I System EISs related to Jordanelle Reservoir (USBR 1979 and USBR 1987).

1.12 Summary of Other Characteristics

The following sections summarize additional characteristics of the Proposed Action and DRP alternatives.

1.12.1 Changes in Land Use and Ownership

Certain components of the Proposed Action and DRP alternatives would lead to temporary and permanent land-use changes, including temporary construction-access roads, permanent ROWs, canal O&M roads, pumping stations and regulating ponds and their associated ROWs.

Temporary access roads would be used to move construction vehicles and equipment from roads to the canal and pipeline ROWs. All types of land uses would be temporarily restricted on the access roads during construction. Existing and planned land uses could resume in these areas after construction.

Permanent ROWs would be established to protect canals and pipelines, and would permanently restrict some land uses. Agricultural land uses could continue within the ROWs after construction, but structures that would interfere with operation or maintenance of facilities would be prohibited within the ROWs. Fencing or roads could be built within the ROWs if the applicant secures the necessary encroachment permit, but structures such as houses, barns and sheds would be prohibited.

All types of land uses would be permanently restricted on the project's O&M roads. However, roads would be available for nonmotorized recreation such as bicycling, jogging and walking. Adjacent property owners would be allowed to use the roads for access to pastures and fields, but all other types of land uses would be prohibited on the roads. Land uses would be permanently restricted in the pumping station and regulating pond ROWs, and no new land uses would be allowed.

Table 1-14 shows land ownership changes that would occur under the Proposed Action and DRP alternatives. The areas shown in Table 1-14 are the same as the fee title areas shown in Table 1-7 (Section 1.8.2.2). Less than 2 acres owned by Heber City would be acquired for both the Proposed Action and the DRP With Pipeline Alternative. This is vacant land north and east of the cemetery on the northeast side of town. Less than 1 acre of state-owned land would be acquired, and no known county or federal land would be needed other than that already owned by the USBR near Jordanelle Reservoir. Approximately 152 acres of land would convert to federal ownership under the Proposed Action, 56 under the DRP With Pipeline Alternative and 111 under the DRP With Canal Alternative.

Tables 1-15, 1-16 and 1-17 show areas that would be temporarily disturbed or permanently removed from current land use under the Proposed Action and DRP alternatives. The following defines each type of land use included in these tables:

- Existing Irrigated Agriculture — Areas where sprinkler or flood irrigation is used to cultivate crops, according to the 1990 Utah Division of Water Resources "Water-Related Land Uses" map (Utah Division of Water Resources 1993)

- Existing Non-Irrigated Agriculture — Areas where livestock are raised without surface irrigation (based on the 1990 Utah Division of Water Resources "Water-Related Land Uses" map)

- Existing Residential — Areas where residential development has occurred as of June 1993. While residential-related land uses could be restricted by the project, no residences would be displaced by the project (based on 1993 field verification and the 1990 Utah Division of Water Resources "Water-Related Land Uses" map)

Table 1-14
Land Ownership Changes Under the Proposed Action and DRP Alternatives

		Existing Ownership of Land to be Acquired[a]			
	Feature	State[b] (acres)	City[c] (acres)	Private (acres)	Totals[d] (acres)
Proposed Action (WCWEP With Daniel Replacement Pipeline)	Canal	0.0	1.4	118.3	119.7
	Pipeline	0.0	0.0	22.0	22.0
	Pump Station	0.0	0.0	1.0	1.0
	Regulating Pond	0.0	0.0	9.2	9.2
	Totals	**0.0**	**1.4**	**150.5**	**151.9**
Daniel Replacement Project With Pipeline Alternative	Pipeline	0.4	1.8	53.3	55.5
	Pump Station	0.0	0.0	0.3	0.3
	Totals	**0.4**	**1.8**	**53.6**	**55.8**
Daniel Replacement Project With Canal Alternative	Canal	0.0	0.0	87.8	87.8
	Pipeline	0.0	0.0	23.2	23.2
	Pump Station	0.0	0.0	0.3	0.3
	Totals	**0.0**	**0.0**	**111.3**	**111.3**

Notes:

[a] Land that may be acquired in fee title from willing sellers at appraised value or by condemnation

[b] State land affected is the UDOT weigh station land located along Highway 40 Southeast of Heber City

[c] Heber City land that would be acquired is vacant land located between the cemetery and Valley Hills

[d] No known federal or county lands would be acquired

Table 1-15
Area to be Temporarily Disturbed or Permanently Removed from Current Land Use Under the Proposed Action (WCWEP With Daniel Replacement Pipeline)

	Acres Temporarily Disturbed and Reclaimed					Acres Permanently Removed from Current Land Use			
	Pipeline Construction Accessway	**Canal Construction Accessway**	**Permanent Pipeline Rights-of-Way**	**Permanent Canal Rights-of-Way**	**Total**	**Canal O&M Roads**	**Pumping Stations**	**Regulating Ponds**	**Total**
Existing Land Uses									
Irrigated Agricultural	76.1	0.0	111.2	6.3	193.6	1.3	0.3	9.2	10.8
Non-Irrigated Agricultural	12.9	0.0	19.0	0.0	31.8	0.0	0.2	0.0	0.2
Residential	5.1	0.0	8.8	0.1	14.0	0.0	0.1	0.0	0.1
Commercial/Industrial	2.4	0.0	4.1	0.0	6.6	0.0	0.0	0.0	0.0
Undeveloped Sagebrush	3.5	6.9	5.0	0.0	15.4	0.0	0.4	0.0	0.4
Undeveloped Riparian	1.0	0.0	1.2	0.0	2.2	0.0	0.0	0.0	0.0
Total	**101.0**	**6.9**	**149.3**	**6.4**	**263.6**	**1.3**	**1.0**	**9.2**	**11.5**

Note: Existing land uses are based on Utah Division of Water Resources 1990 map "Water Related Land Uses" and June 1993 field verification.

Table 1-16
Area to be Temporarily Disturbed or Permanently Removed from Current Land Use Under the Daniel Replacement Project With Pipeline Alternative

	Acres Temporarily Disturbed and Reclaimed					Acres Permanently Removed from Current Land Use			
	Pipeline Construction Accessway	Canal Construction Accessway	Permanent Pipeline Rights-ofWay	Permanent Canal Rights-of-Way	Total	Canal O&M Roads	Pumping Stations	Regulating Ponds	Total
Existing Land Uses[1]									
Irrigated Agricultural	32.8	0.0	46.3	0.0	79.1	0.0	0.3	0.0	0.3
Non-Irrigated Agricultural	4.5	0.0	5.3	0.0	9.8	0.0	0.0	0.0	0.0
Residential	1.6	0.0	1.8	0.0	3.4	0.0	0.0	0.0	0.0
Commercial/Industrial	1.0	0.0	2.1	0.0	3.1	0.0	0.0	0.0	0.0
Undeveloped Sagebrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**39.9**	**0.0**	**55.5**	**0.0**	**95.4**	**0.0**	**0.3**	**0.0**	**0.3**

Note: Existing land uses are based on Utah Division of Water Resources 1990 map "Water Related Land Uses" and June 1993 field verification.

Table 1-17
Area to be Temporarily Disturbed or Permanently Removed from Current Land Use Under the Daniel Replacement Project With Canal Alternative

	Acres Temporarily Disturbed and Reclaimed					Acres Permanently Removed from Current Land Use			
	Pipeline Construction Accessway	Canal Construction Accessway	Permanent Pipeline Rights-of-Way	Permanent Canal Rights-of-Way	Total	Canal O&M Roads	Pumping Stations	Regulating Ponds	Total
Existing Land Uses[1]									
Irrigated Agricultural	7.9	0.0	17.3	15.6	40.8	3.5	0.2	0.0	3.7
Non-Irrigated Agricultural	1.0	0.0	1.6	0.0	2.6	0.0	0.0	0.0	0.0
Residential	0.6	0.0	1.2	4.7	6.5	1.1	0.1	0.0	1.2
Commercial/Industrial	0.0	0.0	0.9	0.7	1.6	0.2	0.0	0.0	0.2
Undeveloped Sagebrush	1.9	23.4	2.2	0.0	27.5	0.0	0.0	0.0	0.0
Total	**11.4**	**23.4**	**23.2**	**21.0**	**79.0**	**4.8**	**0.3**	**0.0**	**5.1**

Note: Existing land uses are based on Utah Division of Water Resources 1990 map "Water Related Land Uses" and June 1993 field verification.

- Existing Commercial/Industrial — Areas where commercial or industrial urban development has occurred that is not residential in nature. While commercial/industrial land uses may be restricted, no buildings would be displaced by the project (based on 1993 field verification and the 1990 Utah Division of Water Resources "Water-Related Land Uses" map).
- Existing Undeveloped Sagebrush — Areas with a predominant ground cover of sagebrush and wheatgrass that are not developed or used for livestock grazing (based on 1993 field verification and the 1990 Utah Division of Water Resources "Water-Related Land Uses" map)

1.12.2 Construction Schedule and Number of Workers

Figure 1-8 shows the construction schedule and estimated number of construction workers for the Proposed Action and DRP alternatives. CUWCD construction management staff would inspect the contractors' work. The Proposed Action would have an estimated 12 construction management and inspection staff. The DRP alternatives would have an estimated six construction management and inspection staff each. Nearly all construction management staff would probably reside in Salt Lake and Utah counties and use the same travel routes as construction workers. Most workers would report to the contractor's yards each morning to receive the day's work assignments and then travel to the work site.

The Proposed Action would be constructed under several contracts lasting about 20 months. The contract for the DRP facilities would likely be expedited, and construction of the DRP facilities would be completed before the WCWEP facilities. The DRP could be supplied water from Jordanelle Reservoir on an interim basis until the WCWEP is operable because surplus CUP water would be available from Jordanelle Reservoir to meet the initial DRP needs without implementing WCWEP during the construction period. Facilities associated with the DRP alternatives would likely be constructed under a single contract lasting 10-13 months. Construction work would be slowed or suspended during the winter.

1.12.3 Employment Opportunities and Payroll

Table 1-18 shows employment opportunities and estimated pay rates for construction, operation, and maintenance of the Proposed Action and DRP alternatives. The Proposed Action and DRP alternatives would employ skilled and unskilled laborers. The Proposed Action would provide the most employment opportunities because it involves the most construction.

Approximately 75 percent of the construction contractors' labor force and nearly all management staff (mostly inspectors) would be non-county residents hired from the Salt Lake City, Provo and Orem areas. The remaining 25 percent of the labor force likely would be Wasatch County residents.

Table 1-18 shows long-term, O&M employment opportunities for the Proposed Action and DRP alternatives. The Proposed Action would be staffed and operated by WCSSA. Approximately five employees would be employed during the irrigation season. It is presumed that they would work on other WCSSA projects during the winter. The CUWCD would transfer operational and maintenance responsibilities for the Proposed Action to WCSSA under a formal agreement.

The DRP alternatives would be staffed and operated by the CUWCD using the same staff that are operating Jordanelle Reservoir. DRP operations and maintenance would require part-time involvement of Jordanelle Reservoir operations staff.

1.12.4 Transportation Requirements

Table 1-19 summarizes construction transportation requirements of the Proposed Action and DRP alternatives. Construction management staff and workers would use pickup trucks and other passenger vehicles to commute to the project sites. The estimated number of round-trips is based on an occupancy rate of one person per vehicle. Commuters traveling from the Salt Lake City area would use U.S. 80 and U.S. 40. Commuters from the Provo-Orem area would use State Route 189 through the Provo Canyon.

Proposed Action (WCWEP With Daniel Replacement Pipeline)

Construction Element	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Canal Rehabilitation, Structures, Pump Sumps, Manifolding, and DRP Pipelines	▨	▨	▨	▨	▨	▨			■ 6	■ 0	■ 17	■ 20	■ 25	■ 30	■ 30	■ 30	■ 20	■ 20	■ 15	■ 10	■ 10						
Distribution Pipelines				▨	▨	▨	▨	▨	▨			■ 10	■ 15	■ 15	■ 25	■ 30	■ 30	■ 25	■ 20	■ 15	■ 10	■ 6					
Pumps, Motors and Electrical																■ 5	■ 2	■ 2	■ 3	■ 3	■ 3	■ 6	■ 6				
Meter Procurement									■	■ (shipped from out of state)	■	■	■	■	■	■											
Supervisory Monitoring																						■ 2	■ 2	■ 1	■ 4	■ 4	■ 3

Daniel Replacement Project With Pipeline Alternative

Construction Element	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Daniel Replacement Pipeline and Pumps	▨	▨	▨	▨	▨	▨			■ 6	■ 14	■ 17	■ 20	■ 25	■ 30	■ 30	■ 30	■ 20	■ 10									

Daniel Replacement Project With Canal Alternative

Construction Element	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Timpanogos Canal Enlargement and Daniel Replacement Pipelines and Pumps			▨	▨	▨	▨	▨	▨			■ 10	■ 15	■ 20	■ 25	■ 30	■ 30	■ 40	■ 40	■ 40	■ 10	■ 5	■ 20	■ 20				

Estimated average number of construction workers by month are shown above shaded construction period. In addition to the numbers shown above, there would be approximately 12 construction management staff on-site working for the CUWCD under the Proposed Action. There would be approximately 6 construction management staff on-site under the Daniel Replacement Project With Pipeline and Daniel Replacement Project With Canal alternatives.

▨ Right-of-way Acquisition (Condemnations extend beyond period shown)

■ Construction Period

Figure 1-8
Construction Schedules and Estimated Number of Construction Workers for the Proposed Action and DRP Alternatives

Table 1-18
Employment Opportunities and Estimated Pay Rates for Construction, Operation and Maintenance of the Proposed Action and DRP Alternatives

Category	Compensation	Work-Months[1]		
		Proposed Action (WCWEP with Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Construction Contractor Forces				
Administrative	$55,000/yr	97	30	39
Supervisory	$45,000/yr	39	14	26
Skilled Labor	$22.96/hr	166	66	98
Unskilled Labor	$10.76/hr	265	92	142
Total Contractor Work Force[2]		**567**	**202**	**305**
Construction Management Staff				
Administrative	$50,000/yr	40	10	12
Professional	$65,000/yr	24	5	8
Technician/Inspector	$35,000/yr	96	15	16
Total Constuction Management Work Force		**160**	**30**	**36**
Operation and Maintenance Staff				
Engineer-Manager	$65,000/yr	6/yr	1/yr	3/yr
Dispatcher/Clerical	$25,000/yr	6/yr	1/yr	2/yr
Field Supervisor	$45,000/yr	6/yr	0/yr	1/yr
Field O&M Laborers	$30,000/yr	12/yr	1/yr	2/yr
Total O&M Work Force		**30/yr**	**3/yr**	**8/yr**

Notes:

[1] A work-month is one person working for one month.

[2] Does not include off-site borrow haul labor.

Table 1-19
Construction Transportation Requirements for the Proposed Action and DRP Alternatives

	Construction Off-Site Traffic in Round-Trips							
	Construction Management Staff		Contractor Worker Vehicles		Pipe Truck Haul		Borrow Truck Haul	
	Total	Peak Daily	Total	Peak Daily	Total	Peak Daily	Total	Peak Daily
Proposed Action (WCWEP with Daniel Replacement Pipeline)	2,000	12	7,200	65	900	30	4,725	48
Daniel Replacement Project With Pipeline Alternative	600	6	4,000	30	720	18	2,775	32
Daniel Replacement Project With Canal Alternative	800	6	4,600	40	270	12	1,110	32

Pipe material would be hauled to the work site on flat-bed semi-trucks. The total number of pipe-haul round-trips would range from 270 to about 900, depending on the alternative. The source of pipe material is unknown, but would likely be hauled from the Salt Lake City area.

Borrow material would consist mainly of pea-sized gravel for pipeline bedding and backfill. It is assumed that borrow material requirements would be met by Heber Valley's existing pits. Two gravel- and rock-crushing operations are located along the southern edge of Heber Valley in the Daniels Creek area. Additional gravel pits are located in the far eastern portion of the Valley in the Lake Creek and Center Creek drainages. Table 1-19 shows the Proposed Action would require the most haul trips (about 4,725 round trips), and the DRP With Canal Alternative would require the least (about 1,110 round trips).

1.12.5 Materials Used During Construction

Table 1-20 summarizes the construction material requirements and quantities that would be needed for the Proposed Action and DRP alternatives. The principal materials used during construction would be gravel, concrete, reinforcing steel (rebar), steel pipe, PVC pipe and woven wire mesh reinforcement. Pumping stations, canal gates and water control structures would require miscellaneous mechanical and electrical components. Chain-link fencing would be used around canal structures, and lumber would be used to form concrete structures. Woven wire would be used as reinforcement in the canal lining.

Pipelines 24 inches in diameter and smaller would likely be PVC. Larger pipelines would be either: reinforced concrete pipe for low-pressure applications; mortar-lined and coated steel pipe; or concrete cylinder pipe for higher-pressure conditions. Mortar-lined and coated steel pipe was used to estimate material requirements.

Borrow material for pipeline backfill would be needed in areas of unsuitable subgrade or cobbly soils. The trench would be over-excavated by 6 inches and backfilled with pea-gravel in these areas. Native material would be used for backfill in other areas. The maximum amount of borrow material that would be needed is based on a worst-case scenario. It was assumed imported material would be required throughout Heber Valley, and the pipe trench would be backfilled with imported material to a level 1 foot above the pipe. The Proposed Action would require 56,700 cubic yards of borrow material under the worst-case scenario (equivalent to an area 400 feet square and 10 feet deep). Exploratory soils investigations would be performed before design to determine the actual need to import backfill. Results of these investigations would likely reduce the amount of borrow material.

1.12.6 Power Sources and Requirements

Colorado River Storage Project (CRSP) power is available to meet the needs of the Bonneville Unit (the CUP in the Great Basin), including Heber Valley. CRSP power would be delivered through existing lines in the Valley and through wheeling agreements with Heber Light & Power (HL&P).

Ten pumping stations would be constructed in Heber Valley under the Proposed Action, and three under the DRP alternatives. Maps A-1 and A-2 (see pocket at back of EIS) show pumping station locations. Table 1-11 in Section 1.8.4.1 summarizes facility sizes, energy requirements and power line extensions or upgrades that would be required to serve Proposed Action and DRP alternative facilities. Existing power distribution lines are located in the valley and within 0.75 mile of the electrical service sites for the Proposed Action and DRP alternatives. Electrical service would be required at about 10 canal gate structures, for intermittent movement of the gates and lighting at night. Gate motors would be 2 hp or less. Table 1-11 in Section 1.8.4.1 shows that the average annual energy use under the Proposed Action and DRP alternatives would range from 802,000 to 3,005,000 kilowatt-hours per year. The 50-hp pumping station shown at the Daniel Middle Pond on Map A-2 (in pocket at back of EIS) would be the same size and at the same location under both of the DRP alternatives.

The Proposed Action would provide pressurized water delivery to some existing sprinkler-irrigated areas now served by pumps along existing canals. Approximately 32 existing pumps — generally small centrifugal pumps averaging 20 hp — would be terminated under the Proposed Action. Landowners normally disconnect the pumps each

Table 1-20
Construction Material Requirements for the Proposed Action and DRP Alternatives

Type of Material	Use of Material	Source of Material	Amount of Material		
			Proposed Action (WCWEP with Daniel Replacement Pipline)	DRP With Pipeline Alternative	DRP With Canal Alternative
Gravel	Pipeline bedding and backfill	Existing borrow pits in local area	56,700 cu yd	33,300 cu yd	13,300 cu yd
Concrete	Canal lining	Local sources	900 cu yd	0 cu yd	3,200 cu yd
	Pipelines >= 27 inches	Local sources	1,400 cu yd	2,100 cu yd	800 cu yd
	Canal checks and turnouts	Local sources	500 cu yd	0 cu yd	200 cu yd
	Diversion structures	Local sources	600 cu yd	200 cu yd	200 cu yd
	Pump sump structures	Local sources	200 cu yd	100 cu yd	100 cu yd
	Total		**3,600 cu yd**	**2,400 cu yd**	**4,500 cu yd**
Pipeline, PVC	Pipelines <= 24 inches	Outside county; source unknown	189,000 lin ft	3,800 lin ft	5,100 lin ft
Steel	Pipelines >= 27 inches	Outside county; source unknown	1,750 tons	2,750 tons	1,050 tons
	Pump sump structures	Outside county; source unknown	10 tons	5 tons	5 tons
	Canal checks and turnouts	Outside county; source unknown	30 tons	0 tons	15 tons
	Diversion structures	Outside county; source unknown	40 tons	15 tons	15 tons
	Total		**1,830 tons**	**2,770 tons**	**1,085 tons**
Woven Wire	Canal lining	Outside county; source unknown	58,500 sq ft	0 sq ft	234,400 sq ft

year and store them during the winter. Most pumps that would be discontinued are along the Sagebrush and Spring Creek and Upper Charleston canals. This area could be served with gravity pressure from the Wasatch Canal without the need for energy under the Proposed Action.

The existing pumps that would be terminated have an estimated total capacity of 600 hp, and use an estimated 1,110,000 kilowatt-hours of electricity per year. HL&P would remove existing transformers and sell the energy to meet other electrical needs in the valley. Landowners would remove existing pumps that would not be needed under the Proposed Action, and continue to use pumps and to irrigate using present methods under the DRP alternatives.

1.12.7 Projected Operational Life and Estimated Costs

Table 1-21 shows the standard operational life of the major project components.

Table 1-21
Standard Operational Life of Major Project Components

Facility	Standard Life (years)
Pipeline	75
Canal	75
Diversion Structure	100
Pumping Station	18-25
O&M Road	35
Power Line	25

Project components would be replaced as they wear out. For example, pumps and motors would be repaired or replaced at intervals during the life of the project, and facilities would be kept in good working order through annual O&M procedures. The typical, overall operational life of projects of this type is at least 100 years before major rehabilitation work would be required. Rehabilitation and ongoing maintenance would indefinitely prolong the operational life of the project.

Table 1-22 shows the estimated costs of the Proposed Action and DRP alternatives.

Estimated capital costs consist of design, ROW acquisition, existing facilities acquisition and construction, but do not include planning, EIS preparation and mitigation. Annual projected operation costs, based on an operational life of 100 years, include maintenance and replacement of project components, and power to operate pumping stations.

1.12.8 Abandonment Procedures

As land in Heber Valley is urbanized and converted to non-irrigated land uses, some of the WCWEP or DRP conveyance facilities may eventually serve M&I uses instead of agricultural uses. However, it may become necessary to abandon some of the pipeline laterals or pumping stations to facilitate construction of roads, houses and other types of development. WCWEP or DRP facilities would likely be abandoned only to accommodate urban development, since they would otherwise be replaced and rehabilitated to continue serving agricultural uses.

If WCWEP or DRP canals or pumping stations are abandoned, mechanical and electrical facilities would be removed and properly disposed. Concrete structures that might interfere with the water flow or present a potential hazard to public safety would be removed, crushed and made available for other purposes such as riprap, or transported to proper disposal facilities. Land developers would need encroachment permits to construct permanent structures within pipeline ROWs, requiring them to remove abandoned pipelines and properly dispose of the material. In some cases, the pipelines would be abandoned by breaching and sealing at selected intervals to prevent movement of water through the pipes. The ROW owner would determine abandonment procedures on a case-by-case basis.

If any canals are not needed to convey water, control and maintenance responsibilities would be transferred to Wasatch County for continued use as flood-control facilities.

Table 1-22
Summary of Estimated Costs of the Proposed Action and DRP Alternatives
(in 1995 dollars)

	Estimated Capital Cost	Estimated Annual O&M Cost
Proposed Action (WCWEP With Daniel Replacement Pipeline)	$34,000,000 - $40,000,000	$200,000 - $400,000
Daniel Replacement Project With Pipeline Alternative	$13,000,000 - $14,000,000	$40,000 - $70,000
Daniel Replacement Project With Canal Alternative	$10,000,000 - $11,000,000	$70,000 - $100,000

1.12.9 Standard Operating Procedures

This section defines standard operating procedures (SOPs) for the Proposed Action and DRP alternatives. SOPs would be followed during construction, operation and maintenance of the project to avoid or minimize adverse impacts on people and natural resources. The mitigation measures identified in Chapter 3 are designed to avoid or minimize adverse and significant impacts of the project that are expected to occur after SOPs have been successfully implemented.

The following sections present the SOPs by resource topic.

1.12.9.1 Standard Construction Procedures

Agricultural

- Farm and ranch owners who may be affected by project construction will be notified of construction procedures and schedules to prevent conflicts with agricultural operations. Procedures to avoid conflicts with agricultural operations will be followed during construction to the maximum extent possible. Unavoidable damage to facilities would be replaced or restored during project construction. Farmers and/or landowners who experience additional unavoidable impacts on agricultural facilities and operations would be compensated for their direct cost of moving or reconstructing facilities. The value of agricultural production on lands acquired would be addressed during the land valuation process that would be used to determine the fair market value of the land.

Air Quality

- CUWCD will follow, to the extent feasible, the EPA's recommendations for aggregate storage pile emissions (AP-42, Section 11.2.3) to minimize dust generated by the project. This will consist primarily of periodic watering of equipment staging areas and dirt roads used during construction.

- Construction machinery will be routinely maintained to ensure that engines remain tuned and emission-control equipment is properly functioning as required by law.

Aquatic Resources

- To the extent feasible, heavy equipment will not be used in stream beds and riparian areas during construction at stream crossings.

- Impacts on aquatic resources can be avoided and minimized by following hazardous materials procedures included under the health and safety SOPs, the revegetation and erosion control SOPs, and wetlands SOPs.

Cultural Resources

- A detailed site inventory will be conducted for the selected project after the EIS process and before construction. This will be conducted by cultural resource experts in areas that would be directly impacted by construction. Data will be recovered and mitigation procedures used when adverse impacts are unavoidable.

Energy Conservation

- Standard energy conservation measures will be used during construction, operation and maintenance, e.g., avoiding unnecessary idling, and keeping vehicles and equipment tuned and maintained.

- The shortest possible transportation routes will be used during construction to conserve fuel.

Health and Safety

- The Utah Occupational Safety and Health Act and the conditions of the federal Occupational Safety and Health Standards will be followed during construction. Copies of these publications and the health and safety SOPs will be provided to project workers at construction sites.

- Warning signs and temporary barriers will be provided in areas used by pedestrians, bicyclists or other recreationists where construction activities are underway.

- Onsite and offsite construction activities will fully conform with the standards in the USBR safety and health standards manual (USBR 1993). These standards include the following items:

- Good housekeeping practices for routine scrap removal from work sites

- Proper handling, storage, use and disposal of toxic materials

- Prohibiting use of alcohol, drugs and firearms

- Restricting public access to work areas to the extent possible
- Providing onsite training to employees exposed to hazards associated with work assignments

- Weekly safety meetings conducted by supervisors for employees under their supervision

- Providing adequate first-aid supplies, trained personnel and emergency evacuation procedures

- Dissemination of information on the hazards of chemicals used, stored or produced in workplaces to employees, contractors, visitors and the public who could potentially be exposed

- Mandatory use of appropriate protective work clothing

- Use of a uniform standard signal system in the operation of cranes, derricks and hoists

- Use of dependable, trained and qualified signal and flag persons wearing high-visibility apparel for traffic control

- Adherence to a detailed fire protection plan (e.g. fuel storage and refueling facilities)

- Proper storage of materials used in construction

- Operation of equipment only by employees qualified to operate the type of equipment assigned

- Providing necessary barricades, walkways, lighting, a public awareness program, and posting for public protection before the start of excavation operations

- The 1995 pre-design Cross Drainage Study will identify the storm runoff potential of local streams and basins for 25- and 100-year flood events. This study will identify both the peak and duration of flows that could occur where project facilities will be located. Appropriate modifications will be made to project design, operational procedures and emergency response plans to minimize flood hazards.

- Automated monitoring systems will be installed during construction to allow monitoring of conveyance flows during operation. This system will allow operators to reduce conveyance flows or releases into stream channels during periods of potential flooding.

Noise

- The location of schools, churches, nursing homes, residential areas and other "sensitive receptors" will be considered when scheduling construction activities with significant noise levels, and in siting temporary and stationary, post-project noise-emission sources.
- Mufflers on construction equipment will be checked regularly to minimize noise.
- CUWCD will follow the noise exposure and hearing conservation standards and practices contained in USBR's manual (USBR 1993) to protect potentially exposed project workers and the public from harmful noise levels.

Revegetation and Erosion Control

Revegetation and erosion control procedures would be implemented where construction of the WCWEP or DRP would disturb soil. These areas are expected to be along new pipeline routes and portions of canals that would be enlarged or rehabilitated. The procedures would be designed to restore vegetation that requires little maintenance and to avoid erosion and sedimentation problems.

The contractor would be required to restore disturbed surfaces to pre-construction conditions and avoid and minimize erosion. Rehabilitation of existing canals along most portions of the Wasatch and Timpanogos canals would be conducted from inside the canal to minimize disturbance. The Humbug Canal and Timpanogos Canal would be re-excavated or reshaped in the flat, farmed areas of Heber Valley, and their embankments reseeded after construction.

The following describes additional revegetation and erosion control procedures:

- Existing topsoil will be carefully removed and stored during trenching operations and replaced after trenches are backfilled. Additional topsoil will be added if needed to allow vegetation growth.
- Disturbed areas will be reclaimed and returned to pre-existing conditions as soon as possible after construction. The contractor will be required to match the natural vegetation or crop cover of adjacent land. Landowners will be paid during the right-of-way (ROW) acquisition process for the cost of reseeding, planting or resodding landscaped areas that are disturbed.
- Areas used for small grains or row crops will be ripped and left bare for the landowner to cultivate and plant at the same time as adjacent farmland.
- In areas subject to erosion, an erosion control blanket or matting will be placed on slopes for stabilization, to prevent wind and water erosion and help establish vegetation. A site analysis will be conducted to determine the appropriate type of mulch and other erosion control material for each area.
- The criteria for selecting species to plant in disturbed areas will include hardiness, compatibility with wildlife, capacity to self-perpetuate and rooting characteristics that help stabilize the soil.
- To maximize the success of revegetation, planting will occur during appropriate climatic periods in properly prepared soil. Planting, watering and fertilizer application techniques will be chosen for specific conditions at each site and the needs of selected plant species.
- Revegetation and erosion control areas will be monitored and repairs made if necessary. Revegetated areas will be monitored for invasion of noxious weeds and other weed species, as required by Section 4.17.3 of the Utah Noxious Weed Act, and appropriate weed control measures implemented. These measures will include establishing a cover of desirable plant species as quickly as possible after construction, interim seeding of topsoil stockpiles if they would remain barren for lengthy periods of time, conducting weed surveys during the fall and spring after initial seedings, applying pesticides or removing the weeds by hand before they develop seeds or spread roots, and applying pesticides in accordance with federal application and

recordkeeping requirements. Monitoring for revegetation success will be conducted for a period of one year for agricultural lands and 3 years for undeveloped lands following completion of initial revegetation. Appendix A provides the details of a noxious weed control program.

- Temporary fencing would be erected in areas where livestock or wildlife will likely interfere with successful revegetation and erosion control.
- Landowners will be compensated during the ROW acquisition if any valuable ornamental trees or shrubs need to be removed or disturbed.

Transportation

- Staging areas for construction material and equipment will be sited to minimize or avoid traffic impacts in residential, commercial, and recreation access areas.
- Traffic control and other safety measures in construction and maintenance areas will be followed to minimize the risks of accidents to vehicles and pedestrians during construction and maintenance of the project.
- Impacts in areas with significant traffic levels, such as critical intersections and primary arterials, will be minimized or avoided to the extent feasible by scheduling equipment transport and material deliveries during off-peak hours. Off-peak hours are those times during any given work day which have traffic volumes less than the highest Annual Average Daily Traffic.
- Roads damaged by project construction activities will be restored to at least the level that existed prior to construction.
- The shortest possible transportation routes will be used to dispose of spoil and waste.
- Construction and traffic control procedures will be designed to allow continued access to businesses and residences.
- Construction and traffic control procedures will be designed to minimize the length of detours.
- Project personnel will control traffic in affected areas.

Visual Resources

Visual resources SOPs are listed below. The revegetation SOPs also would help minimize visual impacts.

- Disturbed areas will be landscaped to match existing and characteristic land forms. When feasible, disturbed areas will be recontoured and slopes rounded along maintenance roads, canals, pipeline alignments, and river banks to blend with surrounding natural contours.
- New plantings will be blended with natural vegetation at the edges, and will be configured to match existing vegetation patterns and provide horizontal and vertical diversity.
- Power poles and other facilities would be located to minimize visual impacts on nearby residents.

Water Quality

The hazardous materials procedures included under the health and safety SOPs and the erosion control SOPs would help avoid and minimize adverse water quality impacts.

Wetlands

- Direct and indirect impacts on wetlands will be avoided, unless there are no other practical (as defined in 40 CFR 230.3 meaning capable of being done, after taking into consideration cost, existing technology and logistics in light of overall project purposes) alternatives Procedures to avoid impacts will include protection of wetlands with silt fencing during construction and avoiding quantity and quality impacts on surface water and groundwater resources that serve as a source of water for wetlands.
- Where impacts on wetlands cannot be avoided, impacts will be minimized to the extent possible and mitigation approaches

will be reviewed with the U.S. Army Corps of Engineers.

- Heavy equipment in wetland areas will be placed on geotextile mats or other measures will be taken to minimize soil disturbance.
- Construction barriers will be installed to prevent unnecessary construction damage to adjacent wetlands.
- Materials excavated from the pipeline trench will be placed on the adjacent roadway or in other upland areas. No excavated material will be placed in any wetland.
- Wetland soils will be removed, segregated and stockpiled in upland areas. The wetland topsoil will be replaced in the top 6 to 12 inches of the pipeline trench.
- After the wetland topsoil is replaced, the disturbed area will be graded to match previous contour elevations.
- The disturbed wetland areas will be revegetated with a mixture of desirable wetland plant species.
- Construction measures will be implemented for the installation of pipelines to prevent draining wetlands, e.g., using cutoff walls if a bedding material is used that could otherwise cause wetlands to be drained.
- A monitoring plan will be established to evaluate the success of mitigation measures. Such mitigation measures will be modified as needed to ensure successful mitigation. Successful mitigation will be determined by the appropriate regulatory authorities (i.e., U.S. Army Corps of Engineers, U.S. Forest Service, NRCS and Utah Division of Wildlife Resources).

Wildlife Resources

- To the extent feasible, canal operation and maintenance roads will be located and constructed to avoid or minimize the removal of large trees.
- To the extent feasible, construction activities on or around important game or non-game species habitat (e.g., deer fawning areas) will be scheduled to avoid the periods of greatest use.
- Impacts on wildlife resources also can be avoided and minimized by hazardous materials procedures included under the health and safety SOPs, the revegetation and erosion control SOPs, and wetlands SOPs.

1.12.9.2 Standard Procedures to be Followed During Operation and Maintenance

Air Quality

- Operation and maintenance vehicles will be routinely maintained to ensure that engines remain tuned and emission-control equipment is properly functioning as required by law.

Energy Conservation

- Standard conservation measures will be used during the project's operation and maintenance, e.g., avoiding unnecessary idling and keeping vehicles and equipment tuned and maintained.

Health and Safety

- The Utah Occupational Safety and Health Act and the conditions set forth in the federal Occupational Safety and Health Standards will be followed during operation and maintenance. Copies of these publications and the health and safety SOPs will be provided to project workers.
- Water will only be conveyed during the winter in open canals that are used to maintain instream flows. All other canals would be dewatered when icing could be a safety hazard. Open canals would be temporarily shut down during winter for short periods when icing is a safety hazard.
- Appropriate fencing and signs will be erected along canals used by the project to deter the public from hazardous areas adjacent to existing and planned residential areas.

- Operation and maintenance activities will conform fully with the standards contained in the USBR safety and health standards manual (USBR 1993). Examples of these standards are listed in the health and safety portion of Section 1.12.9.1.

Land Use

- Existing land uses can continue in the ROWs of buried pipelines after construction. The only exceptions to this are existing structures that can not be rebuilt in the ROWs. If structures need to be displaced, the land owners will be compensated at fair market value. No occupied buildings will be displaced by the project.

1.13 Alternatives Considered But Eliminated From Detailed Analysis

This section identifies the WCWEP and DRP alternatives that have been eliminated from further consideration in this EIS. These alternatives would not meet the project purposes and needs or cause unacceptable and adverse environmental or economic impacts.

1.13.1 Refinement of Project Options During the Initial Planning Stages

The WCWEP and DRP planning process began in late 1991. A number of project options were considered and reviewed in many meetings with the public, environmental groups and Wasatch County officials. These are further described in the project's Preliminary Planning Report (CUWCD 1993a) and summarized in the following paragraphs.

The option of implementing the WCWEP and serving all areas of Heber Valley was eliminated from further consideration for the following reasons: 1) adverse impacts on wetlands in the North Fields and Island Ditch irrigation company areas would likely occur, and 2) the North Fields and Island Ditch irrigation companies decided to not participate in the WCWEP because they did not want to convert to sprinkler irrigation.

Another option that was considered in the project's early phases was the delivery of supplemental instream flows to Heber Valley streams that flow into the Provo River. This option was considered during the "universe of opportunities" phase of the planning because limited availability of water supplies and cost limitations were not considered significant constraints until later. Some streams would have required pumping lifts in excess of 1,000 feet. Stream reaches that required pumping lifts in excess of 500 feet were first eliminated, including Little and Big Pole creeks. The remaining stream reaches totaled approximately 38 miles and included parts of Daniels Creek, Center Creek, Lake Creek, Spring Ditch, Spring Creek, Rock Ditch, Berkenshaw Creek and Snake Creek. Stream reaches that would require pumping to supplement flows were then eliminated because fish populations could be lost during power outages at pumping stations. This reduced the total length of stream reaches still under consideration to approximately 28 miles.

An Instream Flow Work Group was formed to develop specific flow regimes for each of the stream reaches that were still under consideration for inclusion in the WCWEP. An evaluation was conducted of streams which could potentially receive supplemental instream flows either directly or through exchange by eliminating diversions. This evaluation included water supply and cost considerations. Nine streams and ditches were rated against criteria related to their enhancement potential and prioritized for receiving supplemental flows. Conserved water was available for the six top-rated streams. Ditches and streams that were eliminated from further consideration for supplemental flows included Spring, North Fields Middle and Westside ditches, and Daniels, Center, Berkenshaw and Upper Lake creeks. Additional information concerning the assessment and ranking of these streams is found in the report prepared by the Instream Flow Work Group for the Fishery Technical Advisory Committee (CUWCD 1994b).

1.13.2 The WCWEP With Pipelines Alternative

The WCWEP With Pipelines Alternative was created and referred to as the "all-pipeline" alternative because it was designed to minimize conveyance losses by using pipelines for both the DRP and the WCWEP. This is the only alternative that would have converted the entire Heber Valley to sprinkler irrigation. This alternative was eliminated from further analysis for the following reasons:

- Extensive use of pipelines would have impacted riparian vegetation and wetlands along the many canals that would have been dewatered
- The pipeline crossing of the Provo River would have caused unacceptable environmental impacts in the Provo River riparian corridor, while the other alternatives would have used an existing canal to convey water to the west side of the River
- Groundwater elevation levels in the North Fields area would have been lowered, which would have adverse impacts on wetlands, wildlife habitat and current agricultural practices
- Extensive use of pipelines made this the most expensive alternative and its high cost would have exceeded funding limitations defined in CUPCA

1.13.3 The WCWEP and DRP With Pipelines Alternative (not including the Midway, North Fields or Island Ditch Irrigation Companies)

Another "all pipelines" alternative was considered that did not include the Midway area. This alternative would exceed the funding limitations in CUPCA. The extensive use of pipelines would have impacted riparian vegetation and wetlands along the canals that would have been dewatered, and would have exceeded the funding limitations defined in CUPCA.

1.13.4 The WCWEP With Canals Alternatives

The WCWEP With Canals Alternative was an "all canals" alternative that would have conveyed water to DIC and for water efficiency improvements in River Ditch, Wasatch/Humbug, Timpanogos and Sagebrush and Spring Creek canals. No canals would have been enlarged. This alternative was eliminated from further analysis for the following reasons:

- It would not have been able to deliver water to some streams in winter because it did not include pipelines
- It would have used the most energy because it would have required the most pumping
- It would have had the greatest conveyance losses
- It would have required the most maintenance and manpower to operate
- Extensive use of open conveyance systems would have resulted in more liability

1.13.5 The WCWEP With Enlarged Timpanogos Canal Alternative

The WCWEP With Enlarged Timpanogos Canal was another "all canals" alternative. The Timpanogos Canal would have been enlarged and used for Daniels replacement and other WCWEP water. The size of the Timpanogos Canal enlargement would have been greater under this alternative than any other alternative because it would have conveyed both Daniels replacement and other WCWEP water on the east side of the Provo River. Other canals on the east side of the Provo River would have been dewatered. River Ditch would have been used to convey water on the west side of the Provo River. This alternative was eliminated from further analysis for the following reasons:

- It would have dewatered the Wasatch Canal and impacted riparian vegetation and wetlands
- Construction of the new canal embankments would have adversely impacted riparian vegetation and wetlands along the Timpanogos Canal
- It would not have been able to deliver water to some streams in winter because it did not include a conveyance pipeline
- Enlargement of the Timpanogos Canal in this alternative would have been more

expensive than any other alternative which includes an enlarged Timpanogos Canal because the extra capacity would have required re-excavation and construction of new canal embankments

1.13.6 The WCWEP With Wasatch and Enlarged Timpanogos Canals Alternative

This alternative would have used the Wasatch and Humbug canals to convey water only to those lands that could be served without pumping from these canals. Other water delivered by the WCWEP would have been conveyed through an enlarged Timpanogos Canal. A bypass pipeline would have been constructed along the initial two miles of the Timpanogos Canal to avoid enlarging this reach that is located on a steeply sloping hillside. River Ditch would have been used to convey water for sprinkler irrigation to the west side of the Provo River. This alternative would have used canals to convey water on the east side of the River south of Highway 32. This alternative was eliminated from further consideration for the following reasons:

- It could have caused adverse impacts on groundwater levels, local springs and the fish hatchery located on the west side of the Provo River

- Its cost would have exceeded the funding limitations in CUPCA

1.13.7 The WCWEP With Canals and Pipeline Alternative

The WCWEP With Canals and Pipeline Alternative would have used a pipeline to convey the Daniel replacement water and four canals for the WCWEP water (the River Ditch, Wasatch/Humbug, Timpanogos and Sagebrush and Spring Creek canals). The Timpanogos Canal would not have been enlarged. This alternative was eliminated from further consideration for the following reasons:

- It could have caused adverse impacts on groundwater levels, associated wetlands, local springs and the fish hatchery located on the west side of the Provo River

- Its cost would have exceeded the funding limitations in CUPCA

Given the cost constraints and potential environmental impacts noted above, the following modifications were made to this alternative to create the Proposed Action:

- Water deliveries to the west side of the Provo River were eliminated along with deliveries of supplemental flows to Snake Creek

- Modifications to River Ditch were no longer needed given the elimination of deliveries to the west side of the Provo River

- The amount of pipeline used to convey Daniel replacement water was reduced significantly

1.13.8 Strawberry "Pump-Back" Alternative

The USBR studied an alternative that would pump water from Strawberry Reservoir over Daniels Summit to Daniels Creek (USBR 1986). This alternative is also referred to as the Strawberry Valley Pipeline alternative. It would consist of a pumping station and intake at the existing Water Hollow Tunnel outlet on the north shore of Strawberry Reservoir and an 11-mile pipeline through Strawberry Valley and over Daniels Summit. The pipeline would terminate in the vicinity of Lodge Pole Campground where it would release water into Daniels Creek. The pipeline is an alternative to the Daniel Replacement Project because DIC water needs would be met by diversions from Daniels Creek as they are under baseline conditions. Baseline streamflows would be maintained in Daniels Creek and reductions in return flow from Heber Valley to the Provo River and Deer Creek Reservoir would be avoided. The DIC diversion facilities in the upper Strawberry River basin would be rehabilitated and the flows of the streams affected in this basin would be restored.

This alternative is not feasible because CUPCA requires that the restored flows in the upper Strawberry River basin must be released from Strawberry Reservoir into the Strawberry River downstream (Section 303(b)(1)(B) of CUPCA).

CUPCA also requires the DIC replacement water be conveyed to DIC via a pipeline from Jordanelle Reservoir (Section 303(b)(3)(A) of CUPCA). Furthermore, the cost estimate prepared by the USBR in 1986 for this alternative (USBR 1986) would exceed the funding limitation in CUPCA.

1.13.9 The Maximum Management Option

A management option was considered for the five Heber Valley streams that would receive supplemental instream flows under the Proposed Action. This option was referred to as the "Maximum Management Option." The Maximum Management Option included acquisition of land along the streams to provide recreation access, fencing on both sides of the streams to protect the riparian corridor from livestock grazing and to minimize trespassing, and the enhancement of riparian habitat along the streams. The Maximum Management Option is not feasible because a funding source does not exist and Wasatch County officials are opposed to it because of the adverse impacts that would occur on local landowners.

1.13.10 Purchase DIC Water Rights and Land

The alternative of purchasing DIC's water rights and retiring the land served by DIC was considered. This would allow restoration of flows in the upper Strawberry River basin without building a Daniel Replacement Project. This alternative was studied by the USBR (USBR 1986), which determined it was not feasible for the following reasons:

- DIC and Wasatch County officials would adamantly oppose it
- DIC and its customers may not be willing sellers of their water rights or land
- Transferring the water right from the DIC area to the upper Strawberry River basin could cause institutional problems
- Removing DIC agricultural lands from service would reduce return flows in the Provo River system
- The retired land would need to be maintained or developed for some other use

The cost of this alternative would be prohibitive as the value of land in Heber Valley has increased significantly.

1.13.11 Purchase DIC Water Rights Without Retiring Land

This alternative would include the purchase of DIC water rights but without purchasing the land served by DIC. It would be less expensive than the alternative addressed in Section 1.13.10 but would still not be feasible because of the opposition from DIC and Wasatch County, the lack of willing sellers, institutional issues related to the transfer of water rights and the reduction in return flow after irrigation stops on lands served by DIC. This alternative was studied by the USBR and eliminated as not feasible (USBR 1986). It would likely require condemnation of the DIC water right. The remaining water supply of DIC would not be sufficient to grow alfalfa, and the predominant crop would shift to grass hay with reduced yields. Up to about one-third of irrigated land in the company could become barren. Existing land use and values make this alternative less feasible than when it was studied by the USBR.

Wasatch County Water Efficiency Project and Daniel Replacement Project

Draft Environmental Impact Statement

Chapter 2
Comparative Analysis of Impacts of the Proposed Action and Alternatives

Chapter 2
Comparative Analysis of Impacts of the Proposed Action and Alternatives

2.1 Introduction

This chapter presents in summary fashion the impacts of the Proposed Action (WCWEP With Daniel Replacement Pipeline), Daniel Replacement Project (DRP) With Pipeline Alternative, DRP With Canal Alternative, and the No Action Alternative. Additional information regarding the impacts of the Proposed Action and alternatives is provided in Chapter 3 and the Environmental Impact Statement (EIS) draft technical reports. Section 2.2 in this chapter describes the consequences of the No Action Alternative, and Section 2.3 compares the impacts of the Proposed Action with the DRP alternatives by resource topic. The impacts shown in this chapter are the impacts that would occur to baseline conditions. Information on baseline is presented in each resource section of Chapter 3.

2.2 The No Action Alternative

The No Action Alternative would lead to a continuation of the baseline conditions defined in each Affected Environment section of Chapter 3. The No Action Alternative would result in the following consequences:

- Streamflows in the upper Strawberry River basin would not be restored and the Daniel Irrigation Company (DIC) diversion facilities in the basin would not be abandoned or removed
- DIC diversions from the upper Strawberry River basin and Daniels Creek would continue
- Five Heber Valley streams would not receive the target supplemental instream flows included in the Proposed Action
- Pressurized water that would be provided by the Proposed Action and used to help convert Heber Valley flood irrigation systems to sprinkler systems would not be available
- Pumping facilities that would be provided by the Proposed Action for a secondary irrigation water system in Heber City would not be available

2.3 Comparison of Impacts

Table 2–1 documents the quantified impacts of the Proposed Action and each alternative (with the exception of the No Action Alternative). Sections 2.3.1 through 2.3.17 discuss the impacts in Table 2-1 and those that were not quantifiable.

2.3.1 Water Resources

The Proposed Action and DRP alternatives would terminate transbasin diversions from the upper Strawberry River basin to Heber Valley and the Provo River basin. This would increase flows in the Strawberry River and its tributaries and decrease flows in Daniels Creek. Unlike the DRP alternatives, the Proposed Action would change water use applications and efficiencies by facilitating the conversion from flood irrigation systems to sprinkler systems by Heber Valley farmers. The increase in water use efficiency and related reduction in diversion requirements would prevent irrigation water shortages in Heber Valley. On the other hand, both DRP alternatives would increase shortages of agricultural water supplies in Heber Valley for all irrigation companies except DIC because there would be less CUP agricultural water available for contracting. Only the Proposed Action would increase flows in London, Rock and Creamery ditches, Spring Creek and lower Lake Creek. The irrigation conversions facilitated by the Proposed Action would improve the efficiency of water use in Heber Valley and reduce groundwater recharge, storage levels and discharge in Heber Valley. Much smaller reductions in groundwater levels would occur under the DRP alternatives. In spite of the conservation of irrigation diversions, reservoir operational requirements reduce the average storage in Jordanelle Reservoir. Only the DRP alternatives would cause an average monthly reduction in total Heber Valley inflow to Deer Creek Reservoir and in lower Provo River flows below Deer Creek

Table 2-1
Summary of Proposed Action and DRP Alternatives Impacts

Page 1 of 5

Resource Topics	Proposed Action (WCWEP With Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Water Resources			
• Avg. Change in Inflow to Strawberry Res. (ac-ft/year)	+2,900 (+2%)	Same as the Proposed Action	Same as the Proposed Action
• Avg. Change in Monthly Jordanelle Res. Storage (ac-ft)	-8,600 (-4%)	-7,100 (-3%)	-6,800 (-3%)
• Avg. Change in Daniels Creek Flow Above and During DIC Diversions (ac-ft/year)	-2,900 (-35%)	Same as the Proposed Action	Same as the Proposed Action
• Range of Avg. Monthly Flow Changes in 5 Heber Valley Streams Receiving Supplemental Flows (cfs)	+0.5 to +16.9	0	0
• Avg. Monthly Change in Total Heber Valley Inflow to Deer Creek Res. (cfs)	0	-1 (0%)	-1 (0%)
• Avg. Monthly Change in Deer Creek Res. Storage (ac-ft)	-1,100 (-1%)	-1,600 (-1%)	-1,600 (-1%)
• Avg. Monthly Change in Lower Provo River Flow at Provo City Gage (cfs)	0	-3 (-3%)	-3 (-3%)
• Change in Heber Valley Groundwater Levels (feet)	-40 to -60 in southeast portion of Heber Valley -1 to -40 in northern, central and southern portions of Heber Valley	-1 to -2 in northern portion of Heber Valley -1 to -5 in eastern and southern portions of Heber Valley	-1 to -2 in northern portion of Heber Valley -1 to -5 in eastern and southern portions of Heber Valley

Table 2-1
Summary of Proposed Action and DRP Alternatives Impacts

Page 2 of 5

Resource Topics	Proposed Action (WCWEP With Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Water Quality			
• NO_3 Concentrations in Heber Valley Groundwater (mg/L)	Avg. Yrs: 0 Wet Yrs: +0.1 (+9%) Dry Yrs: 0	Avg. Yrs: -0.1 to -0.2 (-9 to -10%) Wet Yrs: 0 Dry Yrs: 0	Avg. Yrs: -0.1 to -0.2 (-9 to -10%) Wet Yrs: 0 Dry Yrs: 0
• TSS Concentrations in Provo River Inflow to Deer Creek Res. (mg/L)	Avg. Yrs: 0 Wet Yrs: -0.5 (-5%) Dry Yrs: 0	Avg. Yrs: -1.2 (-11%) Wet Yrs: 0 Dry Yrs: 0	Avg. Yrs: -1.2 (-11%) Wet Yrs: 0 Dry Yrs: 0
• TP Concentrations in Provo River Inflow to Deer Creek Res. (mg/L)	Avg. Yrs: 0 Wet Yrs: -0.002 (-6%) Dry Yrs: 0	Avg. Yrs: -0.004 (-11%) Wet Yrs: 0 Dry Yrs: 0	Avg. Yrs: -0.004 (-11%) Wet Yrs: 0 Dry Yrs: 0
• NO_3 Concentrations in Provo River Inflow to Deer Creek Res. (mg/L)	Avg. Yrs: 0 Wet Yrs: -0.01 (-6%) Dry Yrs: 0	Avg. Yrs: -0.02 (-12%) Wet Yrs: 0 Dry Yrs: 0	Avg. Yrs: -0.02 (-12%) Wet Yrs: 0 Dry Yrs: 0
• TSS Loads to Deer Creek Res. (kg/yr)	Avg. Yrs: -23,500 (-0.6%) Wet Yrs: 0 Dry Yrs: +65,740 (+2.0%)	Avg. Yrs: +4,400 (+0.1%) Wet Yrs: 0 Dry Yrs: +14,730 (+0.5%)	Avg. Yrs: +4,400 (+0.1%) Wet Yrs: 0 Dry Yrs: +14,730 (+0.5%)
Wetlands			
• Net Change in Wetland Acres	+53.6	+74.3	+74.3

Table 2-1
Summary of Proposed Action and DRP Alternatives Impacts

Resource Topics	Proposed Action (WCWEP With Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Aquatic Resources			
• Change in Pounds of Trout in 5 Streams Receiving Supplemental Flows	+1,616 (+221%)	0	0
• Change in Pounds of Trout in Upper Daniels Creek	Native Trout: -713 (-83%) Total Trout Population: 0	Same as Proposed Action	Same as Proposed Action
• Change in Pounds of Trout in Upper Strawberry River Basin	+16,618 (+914%)	Same as Proposed Action	Same as Proposed Action
Wildlife Resources			
• Net Change in Acres of Wildlife Habitat	+53.6	+74.3	+74.3
Mineral & Energy Resources			
• Energy Used During Operation (kwhr/yr)	Net increase of 1,890,000	Increase of 832,000	Increase of 802,000
Air Quality			
• Max. Vehicle Emissions During Any 12 Month Period of Construction (tons)	Nitrogen oxides: 150 Sulfur oxides: 13 Particulates: 11	Nitrogen oxides: 50 Sulfur oxides: 4 Particulates: 3	Nitrogen oxides: 57 Sulfur oxides: 5 Particulates: 4
Agriculture			
• Production Loss During Construction	-296 AUMs* of grazing/pasture -547 tons of alfalfa -1,960 bushels of barley	-114 AUM of grazing/pasture -199 tons of alfalfa -710 bushels of barley	-54 AUM of grazing/pasture -126 tons of alfalfa -390 bushels of barley
• Annual Change in Production After Construction	+2,001 AUMs of grazing/pasture (+20%) +2,011 tons of alfalfa (+9%) -120 bushels of barley (-0.2%)	-156 AUM of grazing/pasture (-1.6%) -1 ton of alfalfa (-0.0%) no change from baseline for barley	-156 AUMs (-1.6%) -271 tons of alfalfa (-1.2%) no change from baseline for barley

Table 2-1
Summary of Proposed Action and DRP Alternatives Impacts

Resource Topics	Proposed Action (WCWEP With Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Socioeconomics			
• Change in Gross Agricultural Revenue During Construction (total $)	-$43,751 (-2.5%)	-$15,972 (<-1.0%)	-$9,797 (<-1.0%)
• Change in Total Gross Revenue in Wasatch County During Construction (peak annual $)	+$649,000 (<1.0%)	+$365,000 (<1.0%)	+$152,000 (<1.0%)
• Temporary Employment Impacts During Construction (total jobs)	+83	+48	+58
• Change in Gross Agricultural Revenue After Construction ($ per/yr)	+$130,885 (+7.5%)	-$1,178 (<-1.0%)	-$17,117 (-1.0%)
• Change in Total Gross Revenue in Wasatch County After Construction ($ per/yr)	+$316,000 (<1.0%)	+$118,000 (<1.0%)	+$102,000 (<1.0%)
Recreation			
• Change in Recreation Use (angler days/yr)	+10,000 in upper Strawberry River basin	Same as Proposed Action	Same as Proposed Action

Table 2-1
Summary of Proposed Action and DRP Alternatives Impacts

Page 5 of 5

Resource Topics	Proposed Action (WCWEP With Daniel Replacement Pipeline)	Daniel Replacement Project With Pipeline Alternative	Daniel Replacement Project With Canal Alternative
Transportation			
• Peak Increase in Traffic During Construction (daily trips)	154 on Hwy. 189 (+2.5%) 310 on Hwy. 40 (+2.9%)	98 on Hwy. 189 (+1.6%) 172 on Hwy. 40 (+1.6%)	98 on Hwy. 189 (+1.6%) 180 on Hwy. 40 (+1.7%)
• Pipeline Road Crossings	60	12	4

Note:

Impacts in this table are defined by comparing conditions with the Proposed Action and alternatives to baseline conditions (the same way impacts are defined in Chapter 3). Percent change is the change from baseline conditions.

TSS = Total Suspended Solids; NO_3 - Nitrates; and TP - Total Phosphorus

*AUM is animal unit month, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Reservoir. The Proposed Action would reduce groundwater levels in Heber Valley from approximately 2 feet west of Heber City to 60 feet in the Timpanogos Irrigation Company area. The DRP alternatives would not cause a significant change in groundwater levels.

2.3.2 Water Quality

The Proposed Action only would not change nitrate (NO_3) concentrations in Heber Valley groundwater during wet and dry years, and would increase concentrations during wet years. The DRP alternatives would slightly reduce groundwater NO_3 concentrations during average years. The DRP alternatives would reduce NO_3, total suspended solids (TSS) and total phosphorus (TP) concentrations in Provo River inflow to Deer Creek Reservoir about twice as much as the Proposed Action. The Proposed Action would decrease TSS, and NO_3 concentrations in Spring Creek, Lake Creek, London Ditch, and Creamery Ditch. The DRP alternatives would not affect these tributaries. TSS loads to Deer Creek Reservoir essentially do not change during average years under the Proposed Action and the DRP alternatives. During wet years the Proposed Action decreases TSS loads, while the DRP alternatives do not change loads. During dry years TSS loads increase slightly under the Proposed Action but decrease slightly under the DRP alternatives. Deer Creek Reservoir eutrophication and its mixing status would not be affected by the Proposed Action or DRP alternatives.

2.3.3 Wetlands

The Proposed Action only and DRP alternatives would increase the amount of wetlands in the upper Strawberry River basin by the same amount. In the case of the Proposed Action, this increase would be larger than the decrease in wetlands it causes in the Heber Valley. The net increase of wetlands under the Proposed Action would thus be smaller than the net increase caused by the DRP alternatives.

2.3.4 Aquatic Resources

The Proposed Action and DRP alternatives would greatly enhance aquatic resources habitat and trout populations in the upper Strawberry River basin. Only the Proposed Action would cause a major increase in aquatic resources habitat and trout populations in the following Heber Valley streams: London, Rock and Creamery ditches, Spring Creek and lower Lake Creek. The enhancement of trout habitat in these streams may cause adverse and significant impacts on non-game species that prefer existing habitat conditions in the streams, including the leatherside chub. The leatherside chub is a sensitive species in Utah and mitigation is proposed under the Proposed Action to minimize and avoid adverse impacts on this species. While the Proposed Action and DRP alternatives would adversely affect natural trout production and some non-game species in Daniels Creek, the total trout population in this stream would not decline since baseline trout stocking levels would be maintained.

2.3.5 Wildlife Resources

The Proposed Action and DRP alternatives would cause an overall net increase in wildlife habitat, primarily in the upper Strawberry River basin. The Proposed Action would cause a smaller increase than the DRP alternatives, primarily because of the wetland impacts described in Section 2.3.3. It also would permanently remove a small amount of wildlife habitat where a facility ROW would be located.

2.3.6 Threatened and Endangered Species

The Proposed Action and DRP alternatives would not impact spotted frogs. Ute ladies'-tresses would not be directly impacted by the Proposed Action and DRP alternatives. The wetlands habitat that would be indirectly impacted by the Proposed Action is marginal Ute ladies'-tresses habitat that is not considered critical to survival. It also provides habitat for peregrine falcon prey. The Proposed Action and DRP alternatives would not adversely impact the June sucker in the lower Provo River. Bald eagles would benefit from increased trout populations.

2.3.7 Soil Resources

The Proposed Action and DRP alternatives would cause a major reduction in soil erosion at the McGuire and Bjorkman headcuts in the upper Strawberry River basin. Adverse soil impacts in Heber Valley would be minor.

2.3.8 Mineral and Energy Resources

Construction of the Proposed Action and DRP alternatives would require the extraction of gravel from a Heber Valley quarry, which would use energy. The Proposed Action would use the most mineral resources and energy, and the DRP With Canal Alternative would use the least.

2.3.9 Air Quality

Vehicle emissions during construction of the Proposed Action would be greater than those associated with the DRP alternatives, but none would exceed applicable air quality standards. The Proposed Action and DRP alternatives would cause an increase in vehicle emissions after construction as recreation traffic increases.

2.3.10 Agriculture

The Proposed Action and DRP alternatives would cause temporary and permanent impacts on grazing and cropland production in Heber Valley. The production loss during construction would be higher under the Proposed Action than under the DRP alternatives. After construction, the Proposed Action would cause an increase in production while the DRP alternatives would cause a decrease in production.

2.3.11 Socioeconomics

Construction of the Proposed Action and alternatives would increase gross revenue, income and employment in the construction and retail trade sectors of the local economy. The Proposed Action would cause the most positive impacts during construction. Temporary and permanent disturbances to grazing land and cropland would cause a loss of revenue and income in the agricultural sector under the Proposed Action and alternatives. Only the Proposed Action would increase farm revenue, income and profitability after construction. Both DRP alternatives would cause a minor decrease in farm revenue, income and profitability. The increase in recreation caused by the Proposed Action and alternatives would increase revenue and income in Heber Valley's retail trade sector.

2.3.12 Health and Safety

The Proposed Action and DRP alternatives would cause a minor increase in potential safety hazards for construction workers and other drivers because of a slight increase in the risk of traffic accidents. The accidental failure of DRP facilities during a major earthquake, or some other unexpected event, would cause some property damage but such an event is very unlikely.

2.3.13 Noise

The Proposed Action and DRP alternatives would cause adverse noise impacts during construction and from recreation traffic after construction. Some of the noise impacts during construction would be significant for people who walk, drive or reside within 50 feet of construction.

2.3.14 Visual Resources

The Proposed Action would cause more adverse visual impacts than the DRP alternatives because it includes more power poles and construction activities are spread over a greater area. However, none of these impacts would be significant.

2.3.15 Recreation Resources

The Proposed Action and DRP alternatives would restore streamflows and improve fishing in the upper Strawberry River and its tributaries, which would attract additional recreationists to the basin. The Proposed Action would only cause a minor increase in recreation along the five Heber Valley streams receiving supplemental flows. The continuation of baseline trout stocking levels in Daniels Creek would prevent adverse recreation impacts along the creek and from the Proposed Action and DRP alternatives.

2.3.16 Cultural Resources

Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin under the Proposed Action and DRP alternatives would cause adverse and significant impacts on the historic integrity of this canal system, but mitigation is proposed. The Proposed Action and DRP alternatives have potential to cause cultural resource impacts in Heber Valley, but the extent and location of impacts would not be known until complete inventories are conducted before construction.

2.3.17 Transportation

The increase in traffic and number of road crossings during construction of the Proposed Action would be greater than those during construction of the DRP alternatives, but motorists would experience only minor delays. Recreationists driving to streams with restored flows in the upper Strawberry River basin would increase traffic in the basin and in Heber Valley under the Proposed Action and DRP alternatives.

Wasatch County Water Efficiency Project and Daniel Replacement Project

Draft Environmental Impact Statement

Chapter 3
Affected Environment and Environmental Consequences

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

The purposes of this chapter are to describe the affected environment (baseline conditions) of resources of the human environment that would be impacted by the Proposed Action and alternatives, and to document the environmental consequences (direct, indirect and cumulative impacts) on the quality of the human environment under the Proposed Action and alternatives.

This chapter is organized by resource topic. Each resource topic lists the issues addressed in the impact analysis, describes the specific impact area of influence, identifies baseline conditions, establishes significance criteria and documents impacts under the Proposed Action (Wasatch County Water Efficiency Project (WCWEP) With Daniel Replacement Pipeline), the two Daniel Replacement Project (DRP) alternatives and the No Action Alternative. The assumptions and methodology used to analyze impacts for each resource topic are presented in Appendix B, Section B.2. The last four sections of this chapter describe measures that would be used to mitigate significant impacts, unavoidable adverse impacts, net cumulative impacts and irreversible and irretrievable commitment of resources for resource topics.

The impact analysis focuses on issues raised in the public scoping process and on documenting environmental impacts at a level of detail matching the intensity, duration and magnitude of impact. Significant impacts on resources are discussed in detail, and resource impacts that are not significant are summarized. The impact analysis incorporates the Standard Operating Procedures (SOPs), described in Section 1.12.9 of Chapter 1, which would be implemented during construction and operation to protect environmental resources.

The Proposed Action would make possible two local development projects in Heber Valley that are briefly described in this chapter. These projects would not occur under the two DRP alternatives or the No Action Alternative.

The impact analysis presented in this chapter is supported by six technical reports prepared for specific resources, which provide detailed technical information on baseline conditions, analysis methods used to determine impacts, and results of the impact analyses. The following draft technical reports are summarized in resource sections of this chapter:

- Water Resources
- Water Quality
- Wetlands
- Aquatic Resources
- Threatened and Endangered Species
- Cultural Resources

These technical reports are not intended as "stand-alone" documents; they rely on information about the Proposed Action and alternatives that is described in Chapter 1 of this EIS. The technical reports are available from the Central Utah Water Conservancy District (CUWCD) upon request at the following address:

Karen Ricks, Project Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058-7303

3.1.1 General Information

This section provides general information about the direct impact area of influence and environmental resources eliminated from detailed documentation of impacts.

3.1.1.1 Direct Impact Area of Influence

The direct impact area of influence is shown on Map 3-1. It includes four main components: Heber Valley east from the Provo River to the Timpanogos Canal, bounded by Jordanelle Reservoir on the north and Deer Creek Reservoir and Daniels Creek on the south; Daniels Creek through Daniels Canyon to Daniels Pass; the upper Strawberry River basin tributary to Strawberry Reservoir; and the lower Provo River from Deer Creek Reservoir to Utah Lake. The direct impact area of influence is where most of the impacts on environmental resources would occur under the Proposed Action and alternatives. Additional and indirect impacts would occur over a broader area, such as socioeconomics impacts in the rest of Wasatch County.

3.1.1.2 Environmental Impact Topics Eliminated

The impact analysis conducted for this Environmental Impact Statement (EIS) considered all resources of the human environment subject to requirements specified in statutes, regulations or executive orders. Resources not present or not affected by the Proposed Action or alternatives may be eliminated from detailed documentation of impacts or eliminated from further consideration. The following environmental impact topics have been determined to be not present or not affected by the Proposed Action or alternatives:

- Prime or Unique Farmlands

  Heber Valley has farmlands that are used for hay production, miscellaneous grain crops and livestock grazing. However, based on an analysis of Natural Resources Conservation Service (NRCS) data, it was determined that prime or unique farmlands are not present in the area that would be affected by the Proposed Action or alternatives. Prime farmlands are those with soils that have the quality, length of growing seasons and moisture supply needed to economically produce sustainable high crop yields (SCS 1984). Lands affected by the Proposed Action and alternatives do not qualify because of a combination of factors, including length of growing season, soil temperature, depth to shallow groundwater and soil profile characteristics.

- Native American Religious Concerns

  Native American groups or tribes have not raised religious concerns about the lands within the impact area of influence, and the Proposed Action and alternatives would have no known impacts on Native American religious sites, ceremonies and ceremonial sites, burial grounds or other sacred lands.

- Hazardous Wastes

  The Proposed Action and alternatives would not introduce or disturb any known hazardous wastes on lands within the impact area of influence.

- Wild and Scenic Rivers

  The Provo River and its tributaries between Jordanelle Dam and Utah Lake are not protected under the Wild and Scenic Rivers Act of 1968, as amended, and there is no known proposal to protect this reach of the Provo River under the act.

- Wilderness

  The impact area of influence does not cover any lands that are protected now or proposed for protection under the Wilderness Act of 1964.

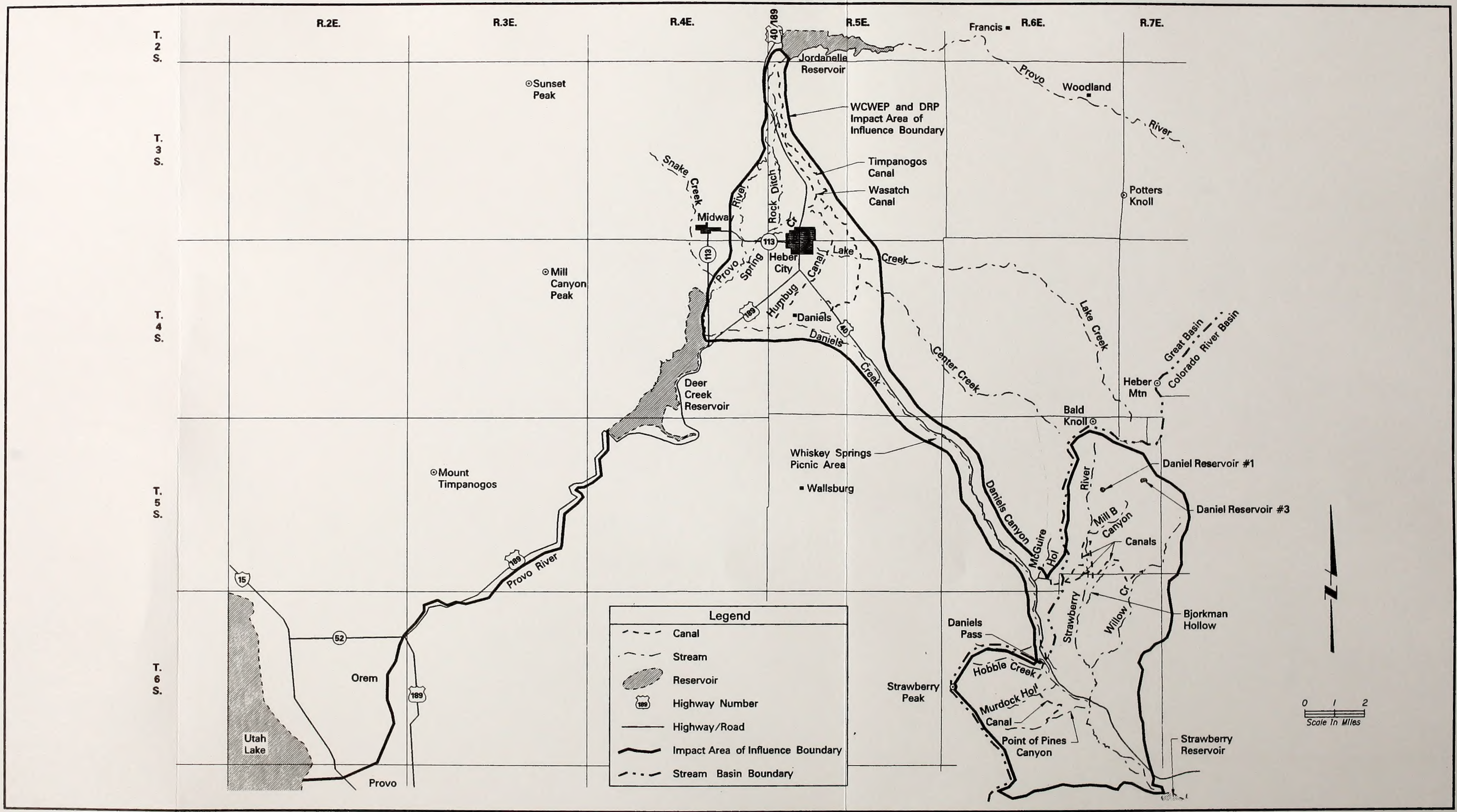
- Land Use Plans and Policies

  The Wasatch County and Heber City comprehensive plans and zoning ordinances do not have designated utility corridors or restrictions on where new pipelines, pumping stations and other related facilities can be developed. Both entities rely upon the review of individual projects by their staff and Boards of Adjustment to ensure that proposed projects do not adversely affect property values, residential areas and amenities. The Proposed Action and alternatives would not lead to conflicts with known or proposed plans or policies of federal, state or local agencies.

Vegetation was considered an impact topic during the analysis of impacts for this EIS. Several other resources contain vegetation as a component: wetlands, wildlife resources, threatened and endangered species, agriculture, and visual resources. Since these resources collectively include all aspects of the vegetation resource that could be impacted by the Proposed Action and alternatives, vegetation was dismissed as a separate EIS impact topic.

3.1.2 Local Development

Two local development projects would be associated with construction of the WCWEP. They are



Map 3–1
Direct Impact Area of Influence

construction of on-farm pipeline and sprinkler systems within the WCWEP delivery system area (On-Farm Improvements) and construction of a secondary water distribution system in Heber City (Heber City Secondary System) to replace the present open ditch distribution system for watering lawns. The WCWEP includes construction of pumping stations that would provide pressurized water for these local development projects under the Proposed Action. The DRP alternatives and the No Action Alternative would not include facilities to pressurize water for either of these two development projects. The timing of implementation of the Heber City Secondary System (HCSS) is dependent on the timing of implementation of the Proposed Action. The HCSS would rely on pumping facilities constructed under the WCWEP and therefore could not precede the WCWEP. Water would be supplied to lands in Heber City from the Wasatch Canal through existing dirt ditches until the HCSS is constructed.

Implementation of the On-Farm Improvements is directly related to the Proposed Action and would occur concurrently with construction of the Proposed Action because the Proposed Action pipeline distribution systems would be the sole source of water supply to lands participating in the WCWEP. The pipeline distribution systems would not have enough capacity to supply sufficient flow rates for flood irrigation. All lands within the WCWEP would be required to be converted to sprinkler irrigation.

Although the CUWCD would not be responsible for the development, construction or operation of on-farm improvements, construction of the WCWEP would reduce the maximum delivery rate to irrigated land to 8.4 gallons per minute per acre. This delivery rate capacity is sufficient for sprinkler irrigation but not for flood irrigation. Landowners participating in the WCWEP would need to convert to sprinkler irrigation at the time of construction of the WCWEP or reduce the amount of land watered until the on-farm improvements are constructed. The conveyance system of the WCWEP would not have capacity to deliver the 17th-class high-flow river water to farms in Heber Valley, thereby ensuring that water would be conserved to supply replacement water to Daniel Irrigation Company (DIC) and supplemental water to streams to be enhanced under the Proposed Action.

This EIS addresses on-farm improvements and water-use changes and identifies related environmental impacts associated with them. The NRCS also is performing an Environmental Assessment of the on-farm changes to meet NEPA compliance for the Tri-Valley Watershed Plan. The change in on-farm water use would be a direct impact of the sizing and construction of the WCWEP delivery system. All of the analysis for the Proposed Action (WCWEP With Daniel Replacement Pipeline) in Sections 3.2 through 3.22 was conducted assuming the on-farm improvements are implemented during or immediately after construction of the Proposed Action.

3.1.2.1 On-farm Improvements

On-farm Improvements would consist of the necessary changes in irrigation equipment and water application and management techniques on each irrigator's land in order to receive water from the WCWEP distribution system. Two types of on-farm changes would occur, depending on whether or not existing land is presently sprinkler or flood irrigated. These two types of changes are discussed in the following sections.

3.1.2.1.1 Improvements on Lands Presently Sprinkler Irrigated. Approximately 40 percent of the lands within the WCWEP are presently sprinkler irrigated and have buried on-farm pipeline systems and surface sprinkler equipment. Most of these landowners have small, 20 horsepower (hp) centrifugal pumps along existing conveyance canals that pressurize water for their private sprinkler systems. Operation and maintenance of the pumps, pipelines and sprinkler equipment is the responsibility of each individual landowner. Under the WCWEP, each qualifying irrigator would be provided a pressurized farm turnout that would include a meter, piping and a shut-off valve. Most turnouts would be located a few feet from existing pumps or near some other convenient point on the property. Each landowner would be responsible for connecting his existing on-farm pipeline main to the WCWEP turnout and removing existing pumping units and electrical connections from the canals. Water application methods on the farms would not change, but the water would be metered and water deliveries would be coordinated with Wasatch County Special Service Area (WCSSA), the operator of the WCWEP delivery system.

3.1.2.1.2 Improvements on Lands Presently Flood Irrigated. Conversion of about 3,675 acres of land that is presently flood irrigated to sprinkler irrigation would be facilitated by the Proposed Action. These acres would be located in the following six irrigation companies: Timpanogos, Wasatch, Extension, Spring Creek, Sage Brush and Charleston (Upper and Lower Canals). About 208,300 feet of underground pipeline and about 206,000 feet of surface sprinkler equipment (mostly wheel or hand-roll lines) would be installed on these lands by the landowners. The underground piping would range from 2 to 6 inches in diameter and the majority would be 4-inch diameter pipe. Riser pipes would be installed approximately every 40 feet along the on-farm pipelines to provide connections for surface sprinkler equipment. Landowners would connect the on-farm pipeline systems to a farm turnout from the distribution system to be constructed on each property 5 acres and greater under the Proposed Action (WCWEP With Daniel Replacement Pipeline). Properties less than 5 acres would share a common turnout with an adjacent landowner. In some cases, owners of small parcels would need to construct pipeline extensions across the land of adjacent landowners to connect to a turnout. These extensions would be 4 inches or less in diameter and less than 2,000 feet long.

The NRCS through the United States Department of Agriculture's Small Watershed Program (Public Law 83-566) will assist landowners in Heber Valley with installation of improved on-farm irrigation systems in cases where land would be converted from flood to sprinkler irrigation. A watershed plan called the Tri-Valley Watershed Plan is currently being developed. Some on-farm irrigation systems would be constructed in Heber Valley concurrently with the WCWEP, and additional on-farm irrigation systems may be constructed in Round Valley (Wallsburg) and South Kamas Valley (Francis-Woodland), and other areas in Heber Valley not included in WCWEP, as part of the Tri-Valley Watershed Plan.

Purposes of the Tri-Valley Watershed Plan are water conservation, improved fish and wildlife habitat, and water quality improvement. The on-farm irrigation systems would fulfill the purpose of water conservation and make possible the Strawberry-Daniel Replacement exchange and the augmentation of flows in certain Heber Valley streams. The on-farm improvement systems would receive priority for Tri-Valley Watershed Plan assistance because conserved water would be used to enhance instream flows to benefit fish habitat. Some water quality improvements could also result from decreased surface runoff and decreased deep percolation.

Local sponsors of the Tri-Valley Watershed Plan are the Wasatch Soil Conservation District and Wasatch County. Sponsoring organizations would be involved in the overall watershed plan, in conducting meetings of the watershed steering committee and the public participation program to be conducted for landowners. Sponsoring organizations could build large facilities such as debris basins and multi-purpose reservoirs under the Small Watershed Program. However, no such facilities are currently proposed in the Tri-Valley Watershed Plan.

Assistance to landowners would be in the form of technical assistance for installation, operation and management of irrigation systems. Financial assistance would be in the form of a 65 percent cost share grant available to landowners whose systems are installed to meet NRCS specifications and whose systems conserve water.

Because part of the justification for this project would be conserved water that would be made available to improve instream flow in streams for fish habitat, only systems that are presently irrigated with unimproved surface systems such as dirt ditches would be eligible for the 65 percent cost-share grants. Preliminary investigation reports by the NRCS indicate that these systems now range from 16 to 28 percent efficiency. With sprinkler systems and assistance with irrigation management, on-farm efficiencies would be increased to approximately 60 percent. Financial assistance would be available to all lands in the WCWEP area that are presently flood irrigated and not jurisdictional wetlands.

Landowners who receive assistance from the PL83-566 Program would have a conservation plan and contract. The contract would cover items to be installed, allowable costs, and amount of cost that would be shared. The conservation plan would provide the landowner with resource information and record decisions on management and conservation of soil, water, air, plants and animals. Because of the large number of landowners in this project, group meetings may be held to discuss management decisions, schedules for installation, documentation requirement for cost share payments, and other items of interest to landowners. Cost share payments would not be made to the landowner until the on-farm irrigation system improvements are installed and demonstrated to meet NRCS specifications.

More information on the PL83-566 program funding availability is included in the Tri-Valley Watershed Plan/Environmental Assessment. If PL83-566 funding is not available when the WCWEP is implemented, landowners would be responsible for 100 percent of the cost of on-farm improvements. Landowners who do not make on-farm improvements would nonetheless receive less water under the WCWEP.

3.1.2.2 Heber City Secondary System

A portion of the water shares of the Wasatch Irrigation Company are owned by individuals who reside in Heber City. Some of these shares have been transferred to Heber City as subdivisions have been developed, and the city continues to obtain shares in the local water companies as a condition of providing culinary water service to new developments. Approximately 465 shares of the Wasatch Irrigation Company are owned by individuals in Heber City. Water is released from the Wasatch Canal and conveyed through dirt ditches to these individuals for landscape watering. Maximum deliveries to the areas inside the city are estimated at about 11 cubic feet per seconds (cfs).

Heber City has proposed to acquire the water shares of the individuals in the town and to construct the HCSS to distribute non-culinary water to residents in the town via pressurized pipelines, thereby conserving both culinary and non-culinary water supplies to help meet future growth needs. It is unlikely, but possible, that Central Utah Project (CUP) M&I water would be conveyed through the HCSS. Heber City has made a request (Sowby and Berg Consultants 1993b) for four delivery locations from the WCWEP:

- 550 East, 850 North, 2,600 gallons per minute (gpm) (5.8 cfs)
- 900 East Center, 900 gpm (2.0 cfs)
- 600 South, 900 East, 700 gpm (1.6 cfs)
- 500 West, 1350 South, 600 gpm (1.5 cfs)

The first location is in the Valley Hills subdivision area on the hill northeast of Heber and above the Wasatch Canal. By acquiring all of the water stock in the city, Heber City would expand the service area of the HCSS to include areas not historically watered from the Wasatch Canal. The Proposed Action includes pumping stations and pipelines to provide pressurized deliveries to the locations listed above at the requested flow rates. Heber City would be responsible for planning, funding and constructing the distribution system of the HCSS from these four locations and annual operation and maintenance costs, including energy costs. The HCSS would include more than 1,500 connections in the city. The water supply associated with the shares inside the city town has averaged about 2,025 acre-feet per year. Heber City may supplement this water supply with CUP Municipal and Industrial (M&I) water.

Pipelines would be constructed along each block of the city. Conveyance pipelines to Heber City would range from 12 to 16 inches in diameter. Most pipeline mains inside the city would be 4 inches in diameter. The system would include about 107,400 feet of 4-inch-diameter PVC pipe and 51,400 feet of pipe ranging from 6 to 16 inches in diameter. The pipeline alignment would follow the city streets.

Implementation and funding of the HCSS is independent of the Proposed Action, but the pumping facilities included in the Proposed Action would improve the ability of Heber City to implement the HCSS. Until the HCSS is implemented, landowners who have irrigation shares of the Wasatch Irrigation Company and who also own land in Heber City would continue to receive their irrigation water for their lawns from existing dirt ditches from the Wasatch Canal.

The HCSS would have no impacts on wetlands, threatened and endangered species, aquatic resources or other environmental resources because the system would be constructed within developed urban City lands and would use an existing water supply.

3.2 Water Resources

3.2.1 Introduction

The information and analysis documented in this section was summarized from the Draft Water Resources Technical Report (CUWCD 1996c), which is available from CUWCD upon request.

This EIS addresses changing water delivery rules and criteria from an internal institutional standpoint, rather than a strict interpretation of Utah water right law. Change in place of use water right applications would need to be approved by the Utah Division of Water Rights in order to implement the changes in water distribution described herein. Water will continue to be distributed to recognized water right holders by the duly appointed river commissioner(s) consistent with the rights as defined by State law, including approved change applications as discussed herein.

The on-farm water efficiency improvements within the WCWEP area described in Section 3.1.2.1 as part of the Tri-Valley Watershed Plan would occur concurrently with implementation of the Proposed Action. All water resource impacts described in this EIS for the Proposed Action (WCWEP With Daniel Replacement Pipeline) include the impacts of the on-farm improvements. Under the DRP alternatives, the on-farm water efficiency improvements of the Tri-Valley Watershed Plan would likely be infeasible, and PL83-566 funding would likely not be available to landowners in Heber Valley. The DRP alternatives, therefore, do not include the water resource impacts of the on-farm improvements.

The assumptions and methodologies used to perform the water resource evaluations are described in Appendix B, Section B.2.1. The water resources analysis addresses potential impacts on surface and subsurface hydrology from the construction, operation and maintenance of the Proposed Action and alternatives. The analysis focuses on potential impacts associated with changes in water use in Heber Valley and termination of transbasin diversions from the upper Strawberry River basin to Daniels Creek in the Provo River watershed.

The following surface water impact topics are addressed in the analysis:

- Changes in the availability of water supplies to water users
- Changes in stream flow
- Changes in reservoir storage, surface area and water surface elevation

The following groundwater impact topics are addressed in the analysis:

- Changes in recharge and discharge to the Heber Valley groundwater basin
- Changes in groundwater basin water levels and storage volumes
- Changes in the timing of outflow from the groundwater basin to local seeps, the Provo River and Deer Creek Reservoir

The water quantity impacts presented in this section provide the basis for evaluating impacts related to agriculture, wildlife, recreation, threatened and endangered species, water quality, aquatics and wetland resources.

The potential of the Proposed Action and alternatives to change the risk of flooding is summarized in the Health and Safety section of this chapter (Section 3.13).

3.2.2 Issues Eliminated From Further Analysis

Some issues raised during scoping were eliminated from further analysis because they do not have potential to be a factor under the Proposed Action and alternatives. The issues were separated into surface water issues and groundwater issues and are described in the following subsections.

3.2.2.1 Surface Water Issues

Following are surface water issues that were eliminated from further analysis and reasons for their elimination:

- What impacts would the Daniel Replacement Project have on water rights exchanges and who would negotiate the exchanges with the Utah State Engineer's Office?

  The Proposed Action and alternatives would not include water right exchanges within the Provo River watershed and thus would not impact such exchanges. No new water right or exchange applications would be filed in the Provo River watershed. Under the Proposed Action, all changes in water diversions in Heber Valley would be implemented by change in place of use applications by the existing water right holders. DIC would assign its interest in the waters of the Strawberry River basin (as set forth in Diligence Claim No. 4 to the CUWCD) in exchange for a replacement water supply from Jordanelle Reservoir. The replacement supply would come from water conserved by water right holders in Heber Valley.

- Who would file change-in-place-of-use applications with the State to include the DIC, North Fields and local streams that would receive supplemental water?

  Under the DRP alternatives, the replacement supply would come from uncontracted Bonneville Unit CUP agricultural water in Jordanelle Reservoir and would not affect any existing water rights.

- How would the Timpanogos Canal be affected if pipelines are used to convey all the water?

  Conveying water through an all-pipeline system was a preliminary alternative that was eliminated from consideration because the cost exceeded available funding and eliminating flows in the Wasatch and Timpanogos canals would have adversely impacted wetland and riparian areas.

- How would water get distributed over the land in the early irrigation season without high flood- irrigation rates?

  The new sprinkler irrigation systems would provide full coverage of irrigated land as described in Chapter 1.

- What impact would changing land uses from farming to nonfarming uses have on future water demand from the DIC?

  The Proposed Action and alternatives would not change agricultural or municipal land uses.

  The Proposed Action and alternatives would not change agricultural or municipal land uses. All of the DIC lands are presently sprinkler irrigated. Changes in land uses from agricultural to residential that may occur independently of the Proposed Action are not expected to change water use because subdivided areas would use approximately the same amount of water per acre as the present sprinkler irrigated areas. Changes in future land use is speculative and would not alter the amount of replacement supply.

- How reliable would the water supply be to the Daniel Upper Pond service area?

  At the time of the scoping sessions, the proposed plan for the Daniel Replacement Project did not include facilities to convey replacement water to the Daniel Upper Pond. Since the scoping sessions, the Proposed Action and alternatives were modified to include a pumping station on the Daniel Middle Pond and a short pipeline connection to the main pipeline of the Daniel Upper Pond distribution system so replacement water could be conveyed to all DIC lands. With this change in project definition, water service in the Daniel Upper Pond area would be more reliable under the Proposed Action and alternatives. This is because a new pumping station at the Daniel Middle Pond would convey the same or greater volume of water from the Daniel Replacement Pipeline to the Daniel Upper Pond system that would have been available from Daniels Creek with the transbasin supply.

3.2.2.2 Groundwater Issues

Following are groundwater issues that were eliminated from further analysis and reasons for their elimination:

- What potential impact could occur to the spring that provides the water supply to the Midway Fish Hatchery?

  Although preliminary alternatives included water efficiency improvements on the west side of the Provo River, none of the final alternatives include the west side. Therefore, no impacts would occur to springs on the west side of the Provo River, including those supplying water to the Midway Fish Hatchery.

- How would groundwater recharge be affected by replacing River Ditch with a pipeline?

  None of the alternatives would affect the River Ditch facility because this system is not proposed to be replaced by a pipeline.

3.2.3 Issues Addressed in the Impact Analysis

3.2.3.1 Surface Water Issues

The following surface water issues were defined during scoping and are assessed in the impact analysis:

- How would river and local stream flows be impacted?
- What would be the affect on reservoir storage levels?
- What would be the impact on water supply?
- How would surface water in upper Daniels Creek be impacted from eliminating the transbasin diversion?
- How would the Wasatch County Water Efficiency Project (WCWEP) affect water conservation?
- How would rehabilitation of the Timpanogos Canal affect seepage that currently provides water to wetlands?
- How would the WCWEP affect canals that currently provide flood control in Heber Valley?

3.2.3.2 Groundwater Issues

The following groundwater issues were defined during scoping and are assessed in the impact analysis:

- What effects would the water efficiency improvements have on groundwater levels and water supply from wells?
- What effects would the water efficiency improvements have on subsurface return flows to streams and springs?
- What impacts would water efficiency improvements have on the water table in the North Fields area and how would those impacts be mitigated?
- What effects would increasing instream flows to Heber Valley streams have on groundwater recharge?
- What effect would water efficiency improvements have on springs in Heber Valley?

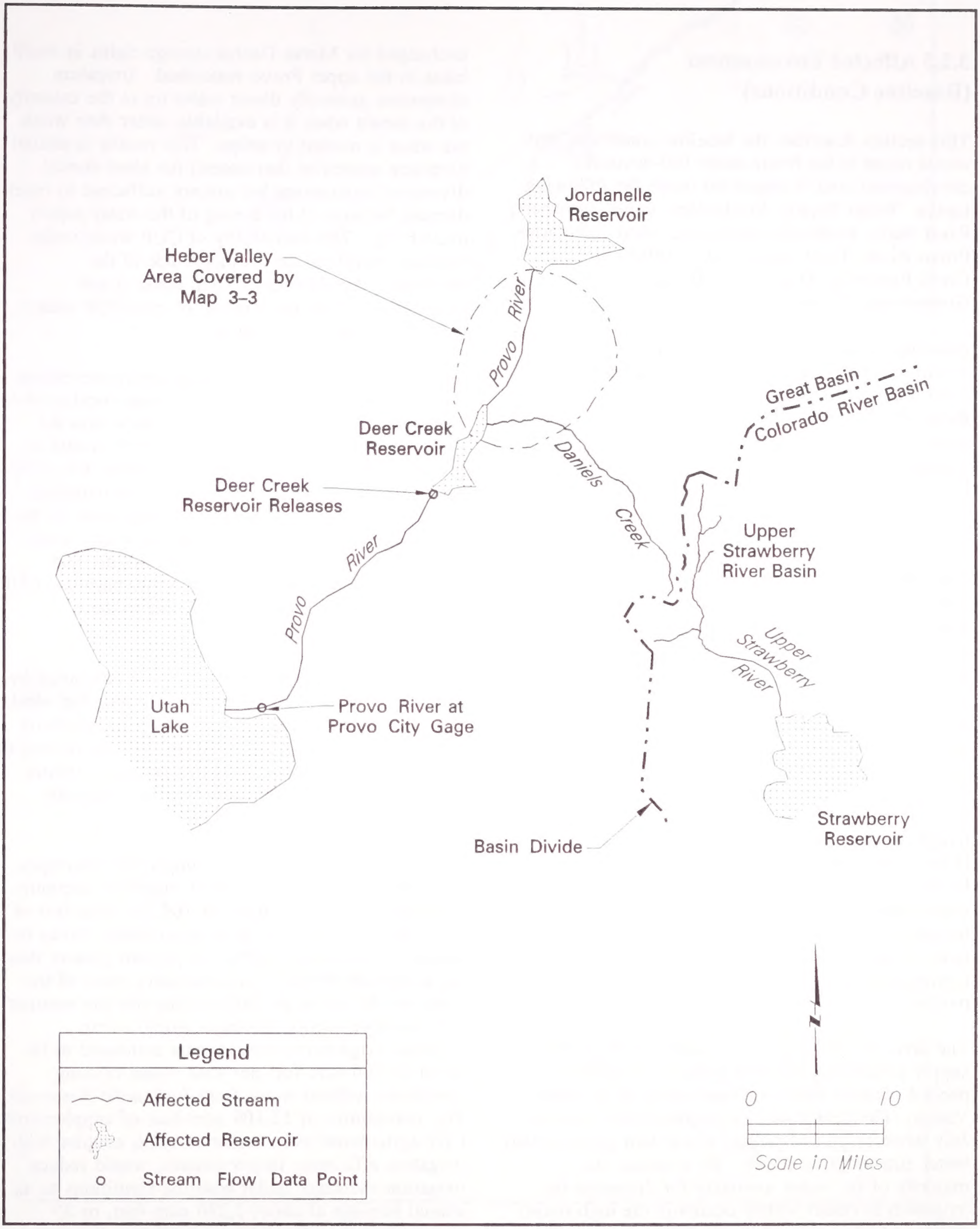
3.2.4 Description of Impact Area of Influence

The water resources impact area of influence under the Proposed Action consists of portions of the Strawberry and Provo River drainages. Map 3-2 shows regional surface water resources that would be affected by the Proposed Action and alternatives. It also includes Heber Valley and the Provo River from Deer Creek Reservoir to Utah Lake. The upper Strawberry River basin portion of the impact area of influence (see Map 3-1 in Section 3.1.1.1) includes the Strawberry River and its tributaries above Strawberry Reservoir. Heber Valley surface water resources that would be affected by the Proposed Action which is shown in more detail on Map 3-3, include Daniels Creek, Rock Ditch, Spring Creek, lower Lake Creek, London Ditch, Creamery Ditch, Jordanelle Reservoir, Deer Creek Reservoir, and the Provo River between Jordanelle and Deer Creek reservoirs.

The DRP alternatives would not change the hydrology of the streams that would receive supplemental flows under the Proposed Action. They are Rock Ditch, Spring Creek, lower Lake Creek, London Ditch and Creamery Ditch. Other streams and reservoirs in the Proposed Action impact area of influence and listed above also are in the impact area of influence of the DRP alternatives.

The impact area of influence for the water supply availability impact topic encompasses all irrigation companies in Heber Valley. Municipal and industrial users in Heber Valley and all other water users outside Heber Valley would not be impacted because the Proposed Action and alternatives would be operated to avoid such impacts.

The groundwater area of influence includes the Heber Valley groundwater basin, which extends from Jordanelle Reservoir in the north to Deer Creek Reservoir in the south.



Map 3–2
Regional Surface Water Resources That Would be Affected by the Proposed Action and Alternatives

3.2.5 Affected Environment (Baseline Conditions)

This section describes the baseline conditions that would occur in the future under full-demand development, and is organized under the following topics: Water Supply Availability, upper Strawberry River basin, Jordanelle Reservoir, Local Tributaries, Provo River, Total Heber Valley Inflow to Deer Creek Reservoir, Deer Creek Reservoir, and Groundwater Resources.

Baseline conditions used in this analysis are future conditions that would occur if the WCWEP and DRP are not implemented when Jordanelle Reservoir becomes fully operational and reaches full water demand levels, as set forth in the Final Supplement to the Final Environmental Impact Statement on the Central Utah Project, M&I System Bonneville Unit (USBR 1987), which was completed before construction of the reservoir. Since CUP water deliveries and some increased irrigation efficiencies would occur under the baseline conditions, baseline hydrology is not the same as existing conditions.

3.2.5.1 Water Supply Availability

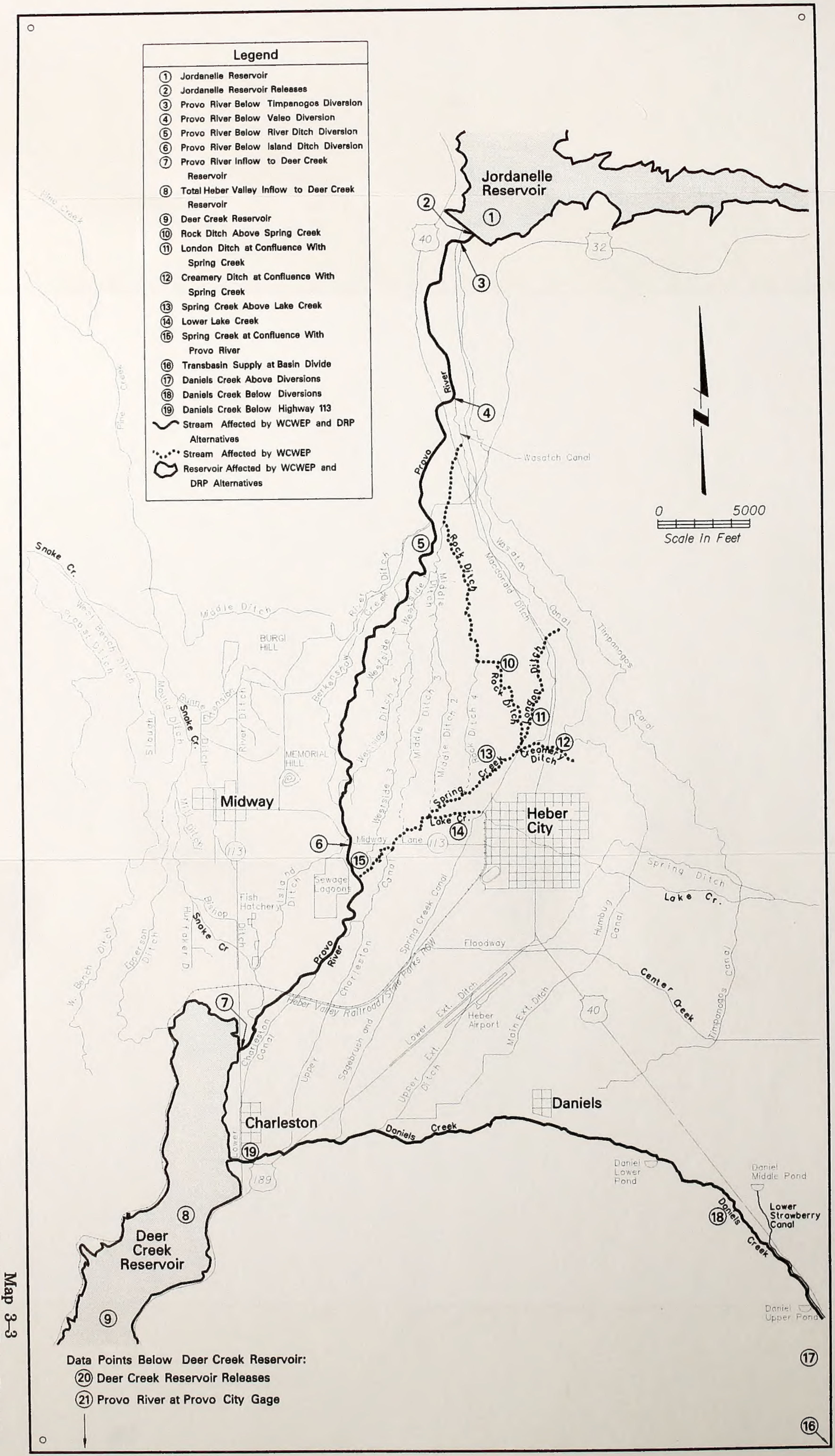
The baseline conditions modeled in the EIS include assumptions that irrigation efficiency would improve in Heber Valley through improved water management and through metering and rehabilitation of water controls structures within the irrigation companies. The diversion requirement in Heber Valley under future baseline was estimated to be 69,840 acre-feet. On-field irrigation efficiencies were assumed to be about 40 percent for flood-irrigated land and 65 percent for sprinkler-irrigated land. Overall flood-irrigated efficiencies (including conveyance losses) were computed to be about 35 percent.

The diversion requirement is based on ideal water supply conditions, wherein water is available when needed. Such a condition does not exist in Heber Valley. The peak diversion requirement occurs in July when crops and grasses reach their greatest daily water consumption levels. By contrast, the majority of the water available for diversion for irrigation in Heber Valley occurs in the high runoff months of May and June, although three irrigation companies that divert from the Provo River have small storage rights in Jordanelle Reservoir that were exchanged for Morse Decree storage rights in small lakes in the upper Provo watershed. Irrigation companies generally divert water up to the capacity of the canals when it is available rather than when the water is needed by crops. This results in annual diversion quantities that exceed the ideal annual diversion requirement but are not sufficient to meet demand because of the timing of the water supply availability. The availability of CUP water under baseline would reduce the magnitude of the shortages. Availability of CUP water is not expected to affect the amount of non-CUP water that is diverted in the valley.

Some companies are able to beneficially use excess water diverted in May and June to raise local shallow groundwater levels so water levels are within the root zone when peak crop consumption occurs in July and the water supply from the Provo River falls below the diversion requirement. Some irrigation companies only have rights to the high flow of the Provo River and do not presently have any water available during the critical months of July and August in some years. However, under baseline, CUP agricultural water would be available to these companies.

Irrigation water supply shortages were computed by comparing the available water supply with the ideal diversion requirement on a month-by-month basis over the study period. A shortage was determined to occur in months when the available supply within any given irrigation company was less than the computed diversion requirement.

The estimated baseline water supply and shortages are listed in Table 3-1 for each irrigation company. Although an average of about 104,300 acre-feet of water per year would be diverted in Heber Valley by irrigation companies (about 50 percent greater than the minimum diversion requirement), most of the water would not be available during the late summer, and therefore supply shortages would occur. Average irrigation shortages were estimated to be about 20,700 acre-feet per year under existing conditions without water from Jordanelle Reservoir. The availability of 12,100 acre-feet of supplemental CUP agricultural water under baseline, coupled with irrigation efficiency improvements, would reduce irrigation shortages under baseline conditions to an annual average of about 3,280 acre-feet, or 85 percent less than the estimated existing shortages. Maximum shortages in an extremely dry year, such


Legend
① Jordanelle Reservoir
② Jordanelle Reservoir Releases
③ Provo River Below Timpanogos Diversion
④ Provo River Below Valeo Diversion
⑤ Provo River Below River Ditch Diversion
⑥ Provo River Below Island Ditch Diversion
⑦ Provo River Inflow to Deer Creek Reservoir
⑧ Total Heber Valley Inflow to Deer Creek Reservoir
⑨ Deer Creek Reservoir
⑩ Rock Ditch Above Spring Creek
⑪ London Ditch at Confluence With Spring Creek
⑫ Creamery Ditch at Confluence With Spring Creek
⑬ Spring Creek Above Lake Creek
⑭ Lower Lake Creek
⑮ Spring Creek at Confluence With Provo River
⑯ Transbasin Supply at Basin Divide
⑰ Daniels Creek Above Diversions
⑱ Daniels Creek Below Diversions
⑲ Daniels Creek Below Highway 113
Stream Affected by WCWEP and DRP Alternatives
Stream Affected by WCWEP
Reservoir Affected by WCWEP and DRP Alternatives
Jordanelle Reservoir
Deer Creek Reservoir
Heber City
Midway
Charleston
Daniels
Provo River
Rock Ditch
London Ditch
Creamery Ditch
Spring Creek
Lake Cr.
Daniels Creek
Snake Cr.
Wasatch Canal
Timpanogos Canal
Spring Ditch
Center Creek
Floodway
Heber Valley Railroad / State Parks ROW
Heber Airport
Sewage Lagoons
Fish Hatchery
BURGI HILL
MEMORIAL HILL
Daniel Lower Pond
Daniel Middle Pond
Daniel Upper Pond
Lower Strawberry Canal
40
32
113
189
0 5000
Scale In Feet
Data Points Below Deer Creek Reservoir:
⑳ Deer Creek Reservoir Releases
(21) Provo River at Provo City Gage

Map 3-3
Heber Valley Surface Water Resources
Affected by the Proposed Action
(WCWEP With Daniel Replacement Pipeline)
and Alternatives

Table 3-1
Estimated Baseline Water Supply and Shortages

Irrigated Area	Water Supply			Shortages (acre-feet)
	Non-CUP (acre-feet)	CUP (acre-feet)	Total (acre-feet)	
North Fields	14,450	4,900	19,350	710
Timpanogos	9,630	2,880	12,510	500
Wasatch Rural	15,100	200	15,300	130
Wasatch Heber	2,020	0	2,020	0
Extension	1,200	570	1,770	90
Spring Creek	4,820	20	4,840	30
Sagebrush	2,710	120	2,830	60
Charleston — Upper Canal	4,900	10	4,910	10
Charleston — Lower Canal	2,470	0	2,470	0
Midway — River Ditch	6,900	570	7,470	370
Midway — Snake Creek & Springs	9,070	960	10,030	310
Island Ditch	2,120	70	2,190	20
Lake Creek	5,850	1,260	7,110	340
Center Creek	2,920	540	3,460	80
Daniel	8,040	0	8,040	630
Totals	**92,200**	**12,100**	**104,300**	**3,280**

as hydrologic year 1961, would be approximately 23,300 acre-feet (about one-third of total need).

3.2.5.2 Upper Strawberry River Basin

Summer flows in the upper Strawberry River basin above Strawberry Reservoir have been diverted by the DIC to the Provo River basin since 1879. DIC transbasin diversion rights are evidenced by Diligence Claim No. 43-1954, filed with the State Engineer, which claims the right to store 750 acre-feet in the Strawberry River drainage and transport Strawberry River basin flows to Daniels Creek for irrigation of 1,800 acres. The claim states a maximum flow rate of 54 cfs from Daniels Creek and drainages in the Strawberry River system, including Strawberry River and Hobble Creek.

In the early 1950s, a dispute between the Strawberry Water Users Association and the DIC arose regarding the amount of water DIC had a right to divert. On July 21, 1952, the two parties entered into an agreement that serves as the basis for quantifying the allowable diversion amount of the claim. The agreement stipulates that the total amount of transbasin diversion by DIC "may be equal when available, but shall not in any event exceed 40,000 acre-feet for any period of 10 consecutive years reckoned in continuous progressive series beginning with the year 1952." (UDNR 1954)

Historical transbasin diversions, from Utah Division of Water Rights records, averaged about 2,900 acre-feet per year for the period 1950-1991 (see Table 3-2, which shows combined totals of the Hobble and Strawberry and Willow ditches). The maximum annual diversion during the period was 5,423 acre-feet in 1971, and the minimum annual was 707 acre-feet in 1977, when only 63 acre-feet was diverted during the critical irrigation months of July through September. Transbasin diversions normally occur from April through October when the ditches in the upper Strawberry River basin are free of snow and ice.

Table 3-2
Historical Strawberry-Daniels Transbasin Diversions

Month	Maximum year (1971) Diversions (cfs)	Minimum Year (1977) Diversions (cfs)	Average Diversions (cfs)	
			(cfs)	(acre-feet)
January	0.0	0.0	0.0	0
February	0.0	0.0	0.0	0
March	0.0	0.0	0.0	0
April	0.0	2.2	0.2	10
May	21.8	5.2	10.2	610
June	40.8	3.2	19.6	1,180
July	14.2	0.9	10.5	630
August	6.8	0.1	4.4	260
September	3.2	0.0	2.3	140
October	2.3	0.0	1.1	70
November	0.0	0.0	0.0	0
December	0.0	0.0	0.0	0
Average Annual	**7.4**	**1.0**	**4.0**	**2,900**

3.2.5.3 Jordanelle Reservoir

Table 3-3 summarizes modeled average monthly Jordanelle Reservoir storage, elevation, and surface area, assuming baseline level of development over the 40-year hydrologic record of 1950-1989. The reservoir has an active storage capacity of about 311,000 acre-feet. Minimum storage of 36,100 acre-feet occurs under January 1962 hydrologic conditions. Under a more extreme or more lengthy dry period (such as the 1930s), the reservoir's drawdown could be even larger. Jordanelle Reservoir was modeled by the U.S. Bureau of Reclamation (USBR) to draw down to the minimum conservation pool of 3,000 acre-feet when planning for construction of the reservoir. Using the 40-year hydrologic record of 1950-1989 as a model, the reservoir would be projected to be 90 percent full or greater (at least 280,000 acre-feet) less than 25 percent of the time. The reservoir's baseline storage stays relatively low during extended dry periods such as occurred in the 1960s.

The reservoir's maximum surface elevation, when full, is 6,166 feet (the top of the flood pool is 6,175 feet). The minimum modeled surface elevation of 5,996 feet occurs under January 1962 hydrologic conditions. The reservoir has a surface area of 3,053 acres when full. The minimum modeled surface area of 555 acres occurs under January 1962 hydrologic conditions.

3.2.5.4 Local Tributaries

3.2.5.4.1 Daniels Creek. Stream flows in Daniels Creek are distinctly different in three reaches. The following subsections describe flows in Daniels Creek above diversions, Daniels Creek below diversions, and Daniels Creek below the Highway 113 bridge.

3.2.5.4.1.1 Daniels Creek Above Diversions. There is only one flow measurement station on Daniels Creek above the locations where water is diverted for irrigation use. There is a USGS gaging station installed above the uppermost diversion from Daniels Creek about 3 miles downstream of the Whiskey Springs picnic area and immediately above the point of diversion to the Daniel Upper Pond. Because of the limited period of data for this location — July 31, 1993 to present — estimated flows were developed using unreported diversion records of DIC from 1980 through 1991. Statistical analysis was used to estimate the flows during years before the period of unofficial diversion records. The resulting estimated creek flows during the summer are shown on Table 3-4.

Table 3-4
Estimated Average Monthly Flows for Daniels Creek Above Diversions

Month	Estimated Monthly Flows(cfs)
April	9.8
May	35.2
June	47.1
July	20.7
August	11.1
September	11.5
October	4.0

Natural flow during the winter, when transbasin diversions do not occur, is about 2 cfs, based on the limited data available from the USGS gage. Winter is the period of minimum flow in the creek.

The Whiskey Springs picnic area is the point of peak flow in Daniels Creek. The channel is normally gaining flow above this point as a result of springs and seepage from the canyon rocks. Below the campground, channel infiltration reduces the creek flow as it enters the Heber Valley alluviums. Flow measurements taken by the CUWCD during 1994 documented the losses in the creek channel between the Whiskey Springs picnic area and the points of irrigation diversion. Channel losses were consistently about 1.5 cfs between the campground and the points of irrigation diversion throughout the range of flows measured. Therefore, peak flow in Daniels Creek near the picnic area is estimated to be 1.5 cfs greater than the flows listed above.

3.2.5.4.1.2 Daniels Creek Below Diversions. DIC has three irrigation diversions from Daniels Creek. A pipeline diverts water from the creek to the Daniel Upper Pond; the Lower Strawberry Canal diverts water from the creek near the Daniel Upper Pond and conveys the water to the Daniel Middle Pond; and the Daniel Lower Pond is immediately adjacent to the creek and diverts water for irrigation use. These ponds are shown on Map A-1 (see pocket at back of EIS). A canal called the Lower Canal, which diverts water in excess of irrigation

Table 3-3
Modeled Average Monthly Storage, Elevation, and Surface Area in Jordanelle Reservoir Under Baseline

Jordanelle Reservoir			
Month	**Storage* (acre-feet)**	**Surface Area (acres)**	**Water Surface Elevation (feet)**
January	216,600	2,328	6,125
February	217,000	2,334	6,125
March	218,400	2,340	6,125
April	230,400	2,431	6,131
May	260,800	2,658	6,145
June	274,300	2,754	6,151
July	251,300	2,589	6,141
August	225,200	2,403	6,130
September	210,400	2,293	6,123
October	210,600	2,288	6,122
November	212,900	2,305	6,123
December	213,400	2,308	6,123
Average	**228,400**	**2,419**	**6,130**

***Rounded**

needs, is located immediately below the Daniel Lower Pond. Water is conveyed westward through this canal along Little Sweden Road and recharges the groundwater basin.

All the flow of Daniels Creek is usually diverted into the Lower Strawberry Canal at the Lower Strawberry Diversion from May through October of each year, except during high runoff from snowmelt. Therefore, the creek channel is usually dry below this diversion between May and October of each year. Natural flow during the winter is usually about 2 cfs. During the winter, undiverted natural flow infiltrates the creek channel below this location and disappears within 1 to 2 miles downstream.

Big Spring is a short distance above the Daniel Lower Pond and has a base flow that usually ranges from 4 cfs during the early irrigation season to 2 cfs during the late summer months. Water from the spring enters the normally dry Daniels Creek channel, flows down the creek channel for a few hundred feet and is diverted from the creek into the Daniel Lower Pond for irrigation use. The creek channel is normally dry in the summer below the Daniel Lower Pond. During the late summer, Big Spring is the sole water source for lands irrigated from the Daniel Lower Pond because the Lower Strawberry Diversion diverts all remaining natural and transbasin runoff from the watershed that is not diverted into the Upper Pond irrigation pipeline system. Other than a short stretch of Daniels Creek between Big Spring and the Daniel Lower Pond that flows continuously, the creek channel is usually dry from the Lower Strawberry Diversion to about 1 mile above the point of inflow to Deer Creek Reservoir.

3.2.5.4.1.3 Daniels Creek Below Highway 113 Bridge. Three canals drain into Daniels Creek at or above the Highway 113 bridge near Deer Creek Reservoir. These are the Sagebrush and Spring Creek Canal, Upper Charleston Canal and Lower Charleston Canal. The flows measured at this location represent the drainage from these three canals, except in the months of May and June in some years when high runoff from snowmelt in the upper portion of the watershed reaches the lower portion of the creek. A USGS water measurement gage was installed on Daniels Creek under the authority of the USBR on the downstream side of State Highway 113 below the last canal inflow point. Flow data was recorded by the USBR only for water years 1986-1991. The USGS resumed measurements at the gage in spring of 1993. A continuous flow has been measured at this location during the period of record as a result of drainage from the canals, even though Daniels Creek is almost always dry a couple of miles upstream. The measurements show an average base flow of approximately 4 cfs throughout the year, with a minimum flow of about 0.1 cfs during later summer in some years.

3.2.5.4.2 Local Tributaries Receiving Supplemental Flow. In addition to Daniels Creek, there are three other major Provo River tributaries in Heber Valley: Snake Creek, Lake Creek and Center Creek. Snake Creek, located on the west side of the Provo River, and Center Creek would not be affected by the Proposed Action. The Proposed Action would affect flows in the portion of Lake Creek downstream of Heber City.

Minor tributaries affected by the Proposed Action include Rock Ditch, London Ditch, Creamery Ditch and Spring Creek. These creeks are shown on Map 3-3 (Section 3.2.4). This section provides additional information concerning baseline flows in each of the streams that would be directly affected by the Proposed Action, except Daniels Creek, which is discussed separately in Section 3.2.5.4.1.

3.2.5.4.2.1 Rock Ditch. As shown on Map 3-3, Rock Ditch diverts water from the Wasatch Canal about 2,000 feet below the Wasatch Diversion on the Provo River. This creek supplies irrigation water to the North Fields Irrigation Company and is a conveyance facility for Provo River water that is discharged into Spring Creek near Heber City for use by other irrigation companies. The highest flows in Rock Ditch occur near the turnout from the Wasatch Canal. The flow of the creek is reduced at the junctions with headworks of the Middle and Westside ditches and the Rock 4 Ditch. There are no known measurements of Rock Ditch available for this reach. Baseline flows in the lower reach normally range from 1 to 11 cfs through the year, dropping to zero during the summer in dry years. Flows are greatest during spring and early summer when Provo River water is being conveyed to the irrigation companies that divert from Spring Creek. These companies rely on local spring and irrigation return flow gains to Spring Creek as their sole source of water during late summer.

3.2.5.4.2.2 London Ditch. London Ditch begins on the east side of State Highway 40 about 1.5 miles north of Heber City. The water rights to London Ditch are privately owned and the water is mostly used for agricultural purposes. The flow in London Ditch increases along its length as seepage and irrigation return flows enter the ditch. The estimated outflow from London Ditch at the confluence with Spring Creek is estimated to range from 1 to 6 cfs.

3.2.5.4.2.3 Creamery Ditch. Creamery Ditch begins at Hatch Spring, approximately 1.5 miles east of State Highway 40 and 0.5 mile north of Heber City. The water rights of Hatch Spring are privately owned and used for irrigation. The ditch flows through wet meadow land and gains in flow along its length. The estimated outflow from Creamery Ditch at the confluence with Spring Creek ranges from 1 to 7 cfs.

3.2.5.4.2.4 Lower Lake Creek. The reach of Lake Creek between the crossing of the Sagebrush and Spring Creek Canal and the confluence with Spring Creek is referred to in this report as lower Lake Creek. This reach of the creek is normally dry except in wet years with high snowmelt runoff because of upstream reservoirs and irrigation diversions. Springtime runoff that exceeds channel capacity through Heber City is bypassed to the flood-control channel and does not pass through this reach.

3.2.5.4.2.5 Spring Creek. Spring Creek is fed by the outflow from the Rock, London and Creamery ditches. Drainage of shallow groundwater levels and irrigation return flows along its length result in large gains in flow as it heads to the Provo River. Two irrigation canals divert water from Spring Creek: the Sagebrush and Spring Creek Canal (50 cfs capacity) and the Upper Charleston Canal (25 cfs capacity).

The USBR installed a gaging station on Spring Creek approximately 300 feet above the crossing of Midway Lane (Highway 113). This gage is a short distance above the Upper Charleston Canal Diversion and below the Sagebrush and Spring Creek Canal Diversion. Gaging records are available for water years 1986 through 1991. The USGS resumed measurement at this location in 1993. Canal diversion records from the Utah Division of Water Rights were used with the gaged data to estimate the flows in Spring Creek.

The estimated flow in Spring Creek above Lake Creek and below the Spring Creek and Sagebrush Canal ranges from 8 cfs to 72 cfs. During summer, the entire flow of Spring Creek is often diverted at the Spring Creek and Sagebrush Canal. There is usually 10 cfs or more of gain in the Creek channel below the canal to supply the Upper Charleston Canal needs. During extremely dry years, the gain is estimated to be only 5 to 6 cfs.

Estimated flow in Spring Creek below the Upper Charleston Canal, which enters the Provo River, ranges from 1 to 54 cfs. The creek is dewatered in most years during the peak irrigation season in this reach immediately below the Upper Charleston Canal.

3.2.5.5 Provo River

Provo River flows under baseline conditions, with Jordanelle Reservoir in full operation, were modeled by the PROSIM model (see Appendix B, Section B.2.1.2.1 for a description of the PROSIM model). Each of the modeled Provo River data points used in this EIS analysis are described in the following subsections and shown on Map 3-2 or 3-3 (Section 3.2.4). Baseline modeled flows at each of the data points described in the following subsections are shown on Table 3-5. Minimum flows between Jordanelle and Deer Creek reservoirs, which would occur from late fall to late winter, would be 125 cfs. Any existing river diversion facilities located between Jordanelle and Deer Creek reservoirs that are incapable of allowing a minimum of 125 cfs to pass at all times would be reconstructed to function properly under baseline. Any changes to river diversion facilities beyond those that would be made under baseline are described as part of the Proposed Action and alternatives.

Section 303(c)(3) and (4) of CUPCA requires the minimum flow in the reach of the lower Provo River from Deer Creek to the Olmstead Diversion to eventually be 100 cfs. It also requires the minimum flow below the Olmstead Diversion to Utah Lake to eventually be 75 cfs. However, baseline conditions in this EIS were defined by assuming the 75 cfs minimum flow requirement is not in effect. It is too speculative at this time to identify necessary and related assumptions needed to define hydrology conditions (in the impact area of influence) once the 75 cfs requirement is implemented. CUWCD has not fully identified a water source for meeting the 75 cfs instream flow in the lower reach of the river at this time. Pursuant

Table 3-5
Baseline Modeled Provo River Flows
Average Monthly Flows in cfs

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
At Jordanelle Reservoir Outlet	128	126	128	192	727	967	628	503	345	129	143	131	**346**
Below Timpanogos Canal	129	127	129	**191**	677	**908**	**574**	473	333	129	143	132	**327**
Below Valeo Diversion	133	132	136	182	536	763	429	350	263	131	148	136	**278**
Below River DItch	133	132	136	180	502	728	407	334	249	131	148	136	**268**
Below Island Ditch	143	144	148	192	517	746	426	349	265	146	160	146	**282**
At Inlet of Deer Creek Reservoir	224	226	230	267	592	823	491	430	365	259	257	232	**366**
At Deer Creek Reservoir Outlet	198	198	208	293	700	927	715	680	558	290	184	181	**428**
At Provo City Gage	51	60	86	152	377	429	11	1	1	21	78	66	**111**

to Section 302(a) of the Central Utah Project Completion Act (CUPCA), "The District shall acquire . . . by purchase from willing sellers or exchange, twenty-five thousand acre-feet of water rights in the Utah Lake drainage basin . . . Water purchase which would have the effect of compromising groundwater resources or dewatering agricultural lands in the Upper Provo River areas should be avoided." Based on the direction of the CUPCA, CUWCD would make every effort to obtain all water rights for the 75 cfs instream flow from areas within the Utah Lake drainage without compromising water resources in the Upper Provo River areas. Purchase of these water rights would, therefore, not affect water rights in Heber Valley, where the WCWEP and DRP is proposed, and would not affect the comparison of impacts of the alternatives in the Heber area.

The 75 cfs instream flow in the lower reach of the Provo River was not modeled by PROSIM for baseline, the Proposed Action or the DRP alternatives. In order to model the instream flow, the results of all future water purchases and exchanges would need to be known to determine how much each diversion would be reduced from the river below Deer Creek Reservoir. Modeled flows at the Provo City gage under baseline conditions are similar to existing flow conditions and were zero during some summer months.

3.2.5.5.1 Provo River at Jordanelle Reservoir Outlet. Jordanelle Reservoir outlet flows represent the total outflow from Jordanelle Reservoir, including controlled releases and spills (see Map 3-3). Average annual baseline releases would be 346 cfs.

3.2.5.5.2 Provo River Below Timpanogos Diversion. Provo River flows below the Timpanogos Diversion represent the flow in the river about 1,500 feet below Jordanelle Dam, below the Timpanogos Diversion, and after the junction of the new and old river channels (see Map 3-3).

3.2.5.5.3 Provo River Below Valeo Diversion. Provo River flows below the Valeo Diversion represent the flow in the river below the diversions to the Timpanogos and Wasatch canals and several small private diversions (see Map 3-3). They include the return flow to the river from the Wasatch bypass channel below the Wasatch Diversion.

3.2.5.5.4 Provo River Below Midway Diversion. Provo River flows below the Midway Diversion represent the flow in the river below the diversion by the River Ditch Canal operated by Midway Irrigation Company (see Map 3-3). Although this location is normally dry through the summer under present conditions, the minimum flow would be 125 cfs under baseline conditions. This location would normally be the point of lowest flow in the river because most major diversions from the river are above this location, and most return flows from Heber Valley return to the river downstream of this location.

3.2.5.5.5 Provo River Below Island Ditch Diversion. Provo River flows below the Island Ditch Diversion represent the flows in the river immediately above the point of inflow from Spring Creek (see Map 3-3). Groundwater return flows above this location are usually equal to or greater than the diversions by the Island Ditch Irrigation Company.

3.2.5.5.6 Provo River Inflow to Deer Creek Reservoir. Provo River inflow to Deer Creek Reservoir includes the inflow to the river from Spring Creek and Snake Creek (see Map 3-3). It also includes all of the remaining return flow from the groundwater basin that returns directly to the river. It does not include all of the inflow to Deer Creek Reservoir, which is described in Section 3.2.5.6.

3.2.5.5.7 Deer Creek Reservoir Releases. Deer Creek Reservoir releases represent the total outflow from Deer Creek Reservoir, including diversions through the Salt Lake Aqueduct (see Map 3-2). Baseline average annual flow at this location is 428 cfs.

3.2.5.5.8 Provo River at Provo City Gage. Provo River at the Provo City gage represents the inflow to Utah Lake, after all diversions from the river and inflow gains (see Map 3-2).

3.2.5.6 Total Heber Valley Inflow to Deer Creek Reservoir

Total inflow to Deer Creek Reservoir from Heber Valley includes the Provo River and Daniels Creek inflow and groundwater return flow from Heber Valley that returns directly to the reservoir. Average annual total inflow from Heber Valley would be 419 cfs; minimum monthly inflow was modeled to be 181 cfs; maximum monthly inflow was modeled to be 2,377 cfs; and average annual inflow ranges from a minimum of 293 cfs in a hydrologic year like 1977 to a maximum of 738 cfs in a hydrologic year like 1986. Table 3-6 shows the total average annual Heber Valley inflow to Deer Creek Reservoir under baseline conditions. Main Creek inflow from Round Valley and other local basin runoff is not included in the amounts shown in Table 3-6.

3.2.5.7 Deer Creek Reservoir

Deer Creek Reservoir has a capacity of 152,400 acre-feet and averages 112,000 acre-feet of storage under baseline conditions as shown on Table 3-7. Minimum storage occurs under September 1960 hydrology at 10,300 acre-feet. Deer Creek Reservoir is less than full for more than 90 percent of the modeled period.

The reservoir, which stores water for the Provo River Water Users Association (PRWUA), was completed in 1941 by the USBR as part of the Provo River Project.. The primary sources of water for the reservoir are transbasin water diverted from the Weber and Duchesne river drainages, and high flows of the Provo River. The PRWUA operates a power generation station at the base of Deer Creek Dam.

3.2.5.8 Groundwater Resources

Approximately 1.5 million acre-feet of water is stored in the Heber Valley groundwater basin (UDNR 1991). The amount does not vary greatly over the 40-year period of hydrologic records. Very little of the groundwater in this basin is used directly for agricultural or M&I water uses. However, the groundwater discharged from the basin (which includes groundwater return flow to surface water) is an important source of water for Deer Creek Reservoir and water users downstream of the reservoir. The basin serves an important water supply function by helping regulate surface water stream flows and irrigation water that is applied in Heber Valley. Water that enters the basin as groundwater recharge takes from a few months to several years to leave the basin as groundwater discharge, depending on where the irrigation water is applied. This delay allows some water that would otherwise not be available to water users below Deer Creek Reservoir to be available because it enters the basin during spring and early summer and returns to the river at Deer Creek Reservoir during late summer and fall. The benefits of Heber Valley diversions and the basin's regulation of surface flows is recognized by the senior water right holders downstream of Deer Creek Reservoir in Utah County. As stipulated in the Morse Decree (Morse Decree 1921), they allow these diversions by the "junior" water right holders in Heber Valley to continue as long as the water returns for use downstream.

3.2.5.8.1 Groundwater Recharge and Discharge. Total average annual groundwater recharge and discharge closely match each other, but seasonal and monthly recharge and discharge are not similar. Sixty percent of the annual groundwater recharge occurs during the irrigation season in May, June and July. Groundwater discharge follows a different pattern, with peak discharge during July, August and September. Table 3-8 shows the average groundwater balance in the impact area of influence

Table 3-6
Total Average Annual Heber Valley Inflow to Deer Creek Reservoir Under Baseline Conditions

Inflow Source	Inflow (cfs)
Provo River	366
Daniels Creek and other local runoff	18
Groundwater	35
Total Inflow to Deer Creek Reservoir **from Heber Valley**	419

Table 3-7
Modeled Average Monthly Storage, Elevation, and Surface Area in Deer Creek Reservoir Under Baseline

Deer Creek Reservoir			
Month	**Storage* (acre-feet)**	**Surface Area (acres)**	**Water Surface Elevation (feet)**
January	111,000	2,099	5,397
February	115,900	2,171	5,399
March	122,200	2,263	5,402
April	125,800	2,305	5,404
May	126,700	2,320	5,404
June	127,000	2,326	5,405
July	115,900	2,161	5,400
August	103,500	1,989	5,393
September	94,500	1,870	5,388
October	94,600	1,874	5,388
November	100,600	1,955	5,391
December	106,200	2,032	5,394
Average	**112,000**	**2,114**	**5,397**
***Rounded**			

under baseline conditions as modeled by MODFLOW (see Appendix B, Section B.2.1.2.1 for a description of the MODFLOW model). The term "balance" is used because the difference in monthly groundwater recharge and discharge determines the change in groundwater storage. As shown in Table 3-8, total average recharge is 91,587 acre-feet per year, while the total average discharge is 91,748 acre-feet per year. The annual change in groundwater storage over the 40-year study period under baseline conditions averages 161 acre-feet. Therefore, there is essentially no change on an average basis, and all the water that is recharged is discharged.

During wet years, groundwater storage increases by 5,780 acre-feet under baseline conditions. In the wet years, more water is recharged and about the same amount of water is discharged, which creates an increase in groundwater storage. The opposite occurs during a dry year. Groundwater storage decreases by about 12,600 acre-feet during a dry hydrologic year. The decrease in storage is the result of a decrease in groundwater recharge during a dry year. A lower water table during a dry year, in turn, results in a flatter slope to the river and a decrease in the flow rate of the groundwater to the river. These dry- and wet-year fluctuations tend to "even out" over the long-term, as demonstrated by the average change in storage value summarized above.

3.2.5.8.2 Groundwater Levels. A fully operational Jordanelle Reservoir under baseline conditions would allow CUP water to be distributed in Heber Valley, which is not available under existing conditions. Availability of CUP water is expected to increase existing springtime groundwater levels in the valley by as much as 18 feet in some areas. The greatest increases would occur in areas along the Timpanogos Canal that have the longest travel time of return flow to the Provo River. The increased water levels were modeled by the groundwater model using the distribution pattern of CUP water assumed for this EIS (see Appendix B, Section B.2.1). These increased water levels are part of the baseline for this EIS in determining the impacts of the Proposed Action and alternatives.

Figure 3-1 is a generalized hydrogeological profile of the groundwater basin for the area south of Heber City along an east-west line running through the intersection of highways 40 and 189. Baseline groundwater elevations in Heber Valley range from 5,400 to 6,000 feet above mean sea level. Groundwater gradients range from 100 feet per mile to 40 feet per mile. Baseline groundwater levels generally follow the land surface topography. Water levels range from depths of zero to 200 feet below surface, as shown on Map 3-4. The groundwater flows mainly in a south and west direction toward Deer Creek Reservoir on the east side of the Provo River, except for the area near Heber City where groundwater flows toward the northeast to Spring Creek. Groundwater is in contact with the surface in many places in the valley — most predominantly in the North Fields Irrigation Company. Wetlands, springs and seeps occur at locations such as these. Seasonal groundwater levels fluctuate from 5 to 15 feet and up to 30 feet from year to year. Groundwater levels are highest between June and October and lowest between January and April. The groundwater levels are highly dependent on irrigation recharge and thus fluctuate in response to irrigation.

3.2.5.8.3 Wells and Springs. About 640 active and inactive water supply wells — most of them 100 to 250 feet deep — are scattered throughout the Valley. Depth to water in these wells ranges from less than 10 feet to more than 250 feet. The total pumping by all of the wells in the valley averages about 1.2 cfs, or 870 acre-feet per year (UDNR 1991). Nearly all wells are used for single-family domestic and livestock purposes. Domestic well pumping is typically restricted to less than 1.5 acre-feet per family by the Utah Division of Water Rights.

The valley contains several springs of both cool, fresh water and hot mineral water. The hot mineral water is believed to originate deep below the valley's fresh-water aquifer, and/or from walls of consolidated bedrock. Therefore, it is believed that groundwater level changes in the aquifer do not affect flows in the hot springs. The fresh-water springs range from just a few gallons of water per minute to over 6,000 gallons per minute (at the Midway Fish Hatchery spring in the southwestern part of the valley). Some of the cool, fresh-water springs are directly fed by groundwater in the aquifer and could be affected by the Proposed Action (WCWEP With Daniels Replacement Pipeline).

Table 3-8
Modeled Groundwater Recharge and Discharge Summary Under Baseline Average Conditions*

(all values in acre-feet)

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Groundwater Basin Recharge													
Unconsumed Ag Water and Precip.	2,734	2,209	1,904	3,017	19,949	18,602	14,662	11,180	8,930	1,755	2,353	2,454	89,749
Supplemental Instream Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Daniels Creek Channel Losses	129	99	161	543	0	273	0	0	0	307	179	147	1,838
Total Groundwater Recharge	2,863	2,308	2,065	3,560	19,949	18,875	14,662	11,180	8,930	2,062	2,532	2,601	91,587
Groundwater Basin Discharge													
Local Drains and Seeps	1,840	1,753	1,664	1,674	2,554	2,885	2,907	2,783	2,725	2,184	2,027	1,919	26,915
Evapotranspiration	0	0	0	0	909	1,817	2,388	2,054	885	0	0	0	8,053
Snake Creek Accretions	575	559	543	529	651	725	715	688	714	624	603	586	7,512
Provo River Accretions	1,902	1,841	1,780	1,759	2,192	2,337	2,472	2,437	2,421	2,199	2,048	1,963	25,351
Deer Creek Reservoir Accretions	1,456	1,317	1,165	1,252	1,711	1,993	2,847	3,118	3,187	2,415	1,840	1,616	23,917
Total Groundwater Discharge	5,773	5,470	5,152	5,214	8,017	9,757	11,329	11,080	9,932	7,422	6,518	6,084	91,748
Groundwater Basin Change in Storage	(2,910)	(3,162)	(3,087)	(1,654)	11,932	9,118	3,333	100	(1,002)	(5,360)	(3,986)	(3,483)	(161)

(all values in cfs)

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Groundwater Basin Recharge													
Unconsumed Ag Water and Precip.	44.5	39.8	31.0	50.7	324.4	312.6	238.5	181.8	150.1	28.5	39.5	39.9	123.4
Supplemental Instream Losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Daniels Creek Channel Losses	2.1	1.8	2.6	9.1	0.0	4.6	0.0	0.0	0.0	5.0	3.0	2.4	2.6
Total Groundwater Recharge	46.6	41.6	33.6	59.8	324.4	317.2	238.5	181.8	150.1	33.5	42.6	42.3	126.0
Groundwater Basin Discharge													
Local Drains and Seeps	29.9	31.6	27.1	28.1	41.5	48.5	47.3	45.3	45.8	35.5	34.1	31.2	37.2
Evapotranspiration	0.0	0.0	0.0	0.0	14.8	30.5	38.8	33.4	14.9	0.0	0.0	0.0	11.0
Snake Creek Accretions	9.4	10.1	8.8	8.9	10.6	12.2	11.6	11.2	12.0	10.1	10.1	9.5	10.4
Provo River Accretions	30.9	33.1	28.9	29.6	35.6	39.3	40.2	39.6	40.7	35.8	34.4	31.9	35.0
Deer Creek Reservoir Accretions	23.7	23.7	18.9	21.0	27.8	33.5	46.3	50.7	53.6	39.3	30.9	26.3	33.0
Total Groundwater Discharge	93.9	98.5	83.8	87.6	130.4	164.0	184.2	180.2	166.9	120.7	109.5	98.9	126.6
Groundwater Basin Change in Storage	(47.3)	(56.9)	(50.2)	(27.8)	194.1	153.2	54.2	1.6	(16.8)	(87.2)	(67.0)	(56.6)	(0.6)

Notes:

*Based on MODFLOW model output for baseline level of development assumptions.

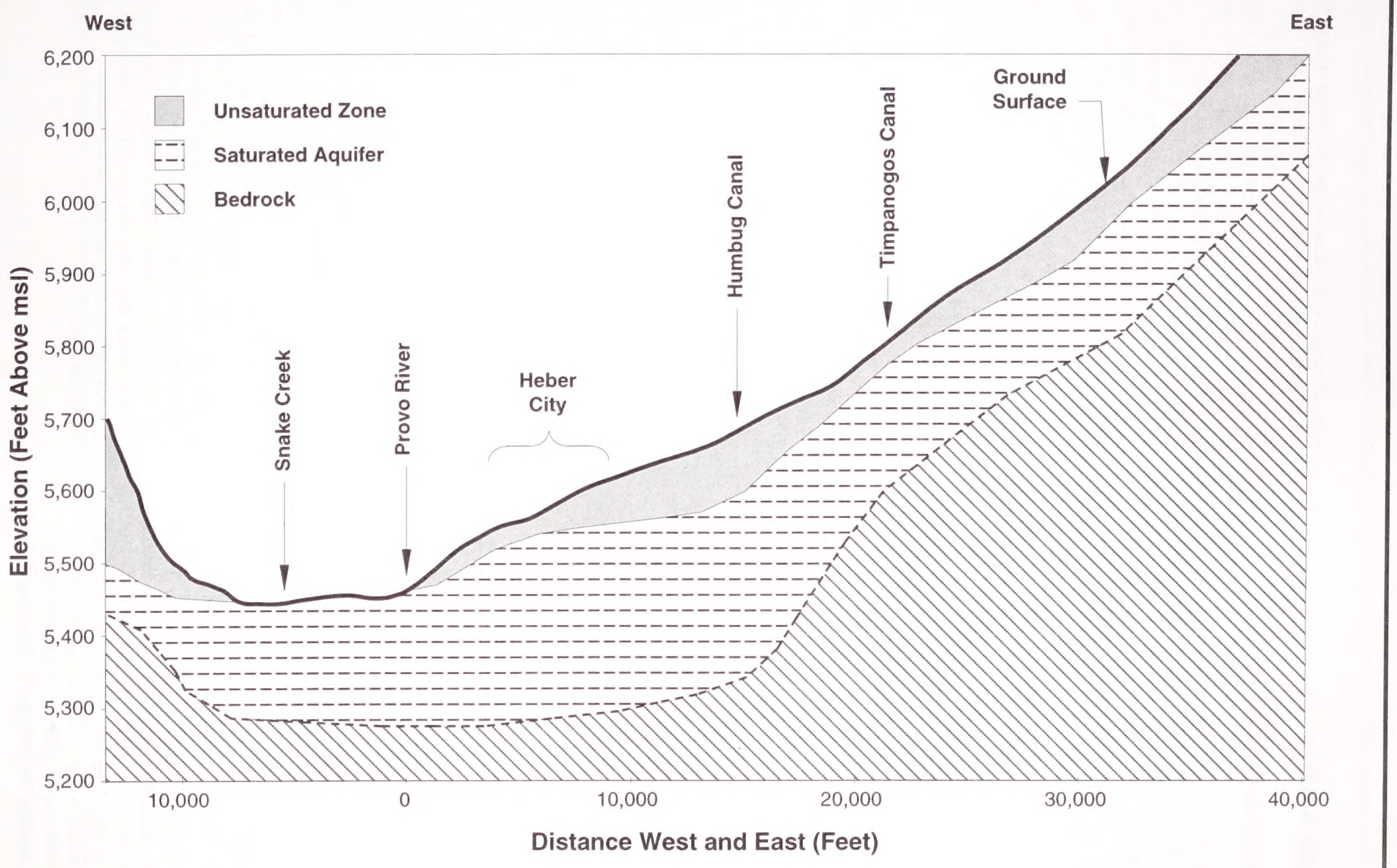


Figure 3-1
Generalized Hydrogeologic Profile of Southern Portion of Heber Valley

3.2.6 Impact Analysis

3.2.6.1 Significance Criteria

Water supply availability impacts were considered significant if any of the following would be reduced: 1) agricultural or M&I water supplies downstream of Deer Creek Reservoir, 2) M&I water supplies in Heber Valley or 3) non-CUP agricultural water supplies in Heber Valley.

Impacts on CUP agricultural water suplies in Heber Valley were considered significant if an action would result in an increase in shortages compared to existing conditions. Impacts on wells were considered significant if a well became incapable of producing water. Any decrease in the flow of a spring used for water supply or which supports aquatic life was considered to be potentially significant.

Significance criteria for the other surface water and groundwater impact topics are not needed because the modeled impacts defined by this analysis are used by other resource topics to determine the significance of the impacts. These other hydrology-related resource topics include water quality, aquatic resources, wetlands, T&E species and recreation.

3.2.6.2 Potential Impacts Eliminated From Further Analysis

No potential impact issues raised during public scoping sessions were eliminated from analysis.

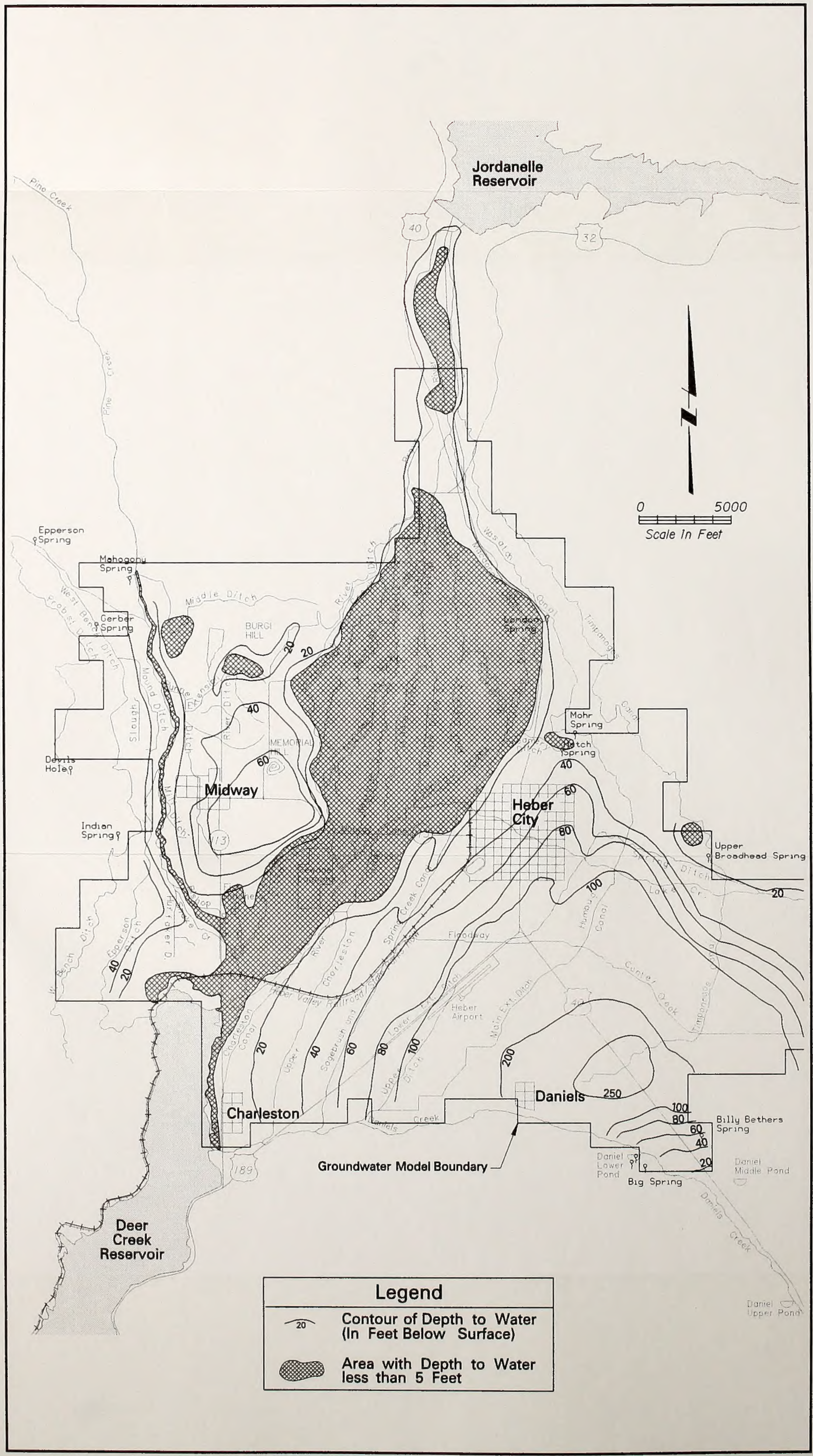
3.2.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

This section describes the potential impacts under the Proposed Action and is organized under the following topics: Water Supply Availability, upper Strawberry River basin, Local Tributaries, Provo River, Jordanelle and Deer Creek reservoirs, and Groundwater Resources.

3.2.6.3.1 Water Supply Availability. Table 3-9 compares the modeled water supplies and shortages under the Proposed Action with baseline. Diversions of non-CUP water would be reduced by about 31 percent as a result of reduced demand associated with water efficiency improvements. DIC would receive an average of 2,900 acre-feet per year of conserved water as replacement water, based on an agreement between the CUWCD, DIC and Utah Department of Water Resources, which establishes terms for terminating diversions from the upper Strawberry River basin. The supply would be 3,025 acre-feet in most years and would be reduced to 1,800 acre-feet 10 percent of the years during dry conditions. The replacement supply would be delivered during the late irrigation season (July-September) and would reduce irrigation shortages in the DIC. Under the Proposed Action, DIC would not need or receive CUP agricultural water. Computed average water supply shortages in the DIC would be reduced by 560 acre-feet per year, from about 630 acre-feet per year under baseline conditions to about 70 acre-feet per year under the Proposed Action.

An average of 12,100 acre-feet per year of CUP agricultural water would be available to the other irrigation companies in Heber Valley. These companies would conserve sufficient quantities of water from their existing water supplies (through decreased diversion demands) to provide water for the DRP and target local instream flows. Average irrigation shortages in the valley would be reduced from about 3,280 acre-feet per year under baseline conditions to about 1,720 acre-feet under the Proposed Action, a 48 percent decrease. Remaining shortages would decrease by 2 percent, from 4.7 percent under baseline to 2.7 percent of the total diversion requirement under the Proposed Action.

Existing Provo River water supplies associated with lands in the Spring Creek, Sage Brush and Charleston irrigation companies, which would participate in the WCWEP, would be conveyed through the Wasatch Canal rather than through the North Fields, as has occurred historically. An average of 2,480 acre-feet of water made available by irrigation efficiency improvements in other companies would be made available to the North Fields district to maintain historical shallow groundwater levels. Increased seepage losses along Rock Ditch associated with increased flow also would help maintain shallow groundwater levels within the North Fields meadow grasslands. Increased Rock Ditch losses associated with year-round flow offset the reduction in springtime water conveyed through Rock Ditch to Spring Creek for other water users, resulting in an overall reduction in irrigation shortages in the North Fields district.



Map 3-4
Estimated Baseline Depth to Groundwater

Table 3-9
Estimated Water Supply and Shortages
Under Proposed Action and DRP Alternatives

Proposed Action (WCWEP With Daniel Replacement Pipeline)						Daniel Replacement Project With Pipeline					Daniel Replacement Project with Canal				
Irrigated Area	Water Supply					Water Supply					Water Supply				
	Non-CUP	CUP	DRP	Total	Shortages	Non-CUP	CUP	DRP	Total	Shortages	Non-CUP	CUP	DRP	Total	Shortages
	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)
North Fields	11,910	4,900	0	16,810	480	14,450	3,700	0	18,150	1,190	14,450	3,490	0	17,940	1,340
Timpanogos	2,650	2,880	0	5,530	200	9,630	2,200	0	11,830	830	9,630	2,080	0	11,710	930
Wasatch Rural	7,520	200	0	7,720	50	15,100	160	0	15,260	170	15,100	150	0	15,250	170
Wasatch Heber	2,020	0	0	2,020	0	2,020	0	0	2,020	0	2,020	0	0	2,020	0
Extension	670	570	0	1,240	40	1,200	430	0	1,630	140	1,200	410	0	1,610	160
Spring Creek	3,680	20	0	3,700	20	4,820	20	0	4,840	30	4,820	20	0	4,840	30
Sagebrush	1,490	120	0	1,610	40	2,710	90	0	2,800	80	2,710	90	0	2,800	80
Charleston - Upper Canal	2,580	10	0	2,590	5	4,900	5	0	4,905	10	4,900	5	0	4,905	10
Charleston - Lower Canal	480	0	0	480	10	2,470	0	0	2,470	0	2,470	0	0	2,470	0
Midway - River Ditch	7,120	570	0	7,690	150	6,900	445	0	7,345	450	6,900	420	0	7,320	480
Midway - Snake Creek & Springs	9,080	960	0	10,040	240	9,070	735	0	9,805	460	9,070	700	0	9,770	500
Island Ditch	2,120	70	0	2,190	15	2,120	55	0	2,175	30	2,120	50	0	2,170	30
Lake Creek	5,780	1,260	0	7,040	340	5,850	950	0	6,800	590	5,850	890	0	6,740	640
Center Creek	2,900	540	0	3,440	60	2,920	410	0	3,330	140	2,920	385	0	3,305	160
Daniel	3,500	0	2,900	6,400	70	2,990	0	2,900	5,890	70	2,990	0	3,410	6,400	70
Totals	63,500	12,100	2,900	78,500	1,720	87,150	9,200	2,900	99,250	4,190	87,150	8,690	3,410	99,250	4,600
Baseline Totals	92,200	12,100	---	104,300	3,280	92,200	12,100	---	104,300	3,280	92,200	12,100	---	104,300	3,280
Percent Change from Baseline	-31%	0%	---	-25%	-48%	-5%	-24%	---	-5%	28%	-5%	-28%	---	-5%	40%
Diversion Requirement					63,770					70,450					70,450
Shortage in Total Diversion Requirement					2.7%					5.9%					6.5%
Baseline Shortage in Total Diversion Requirement					4.7%					4.7%					4.7%
Shortage Change from Baseline					-2.0%					1.2%					1.8%

An average of about 23,700 acre-feet of water per year would be conserved as an indirect result of the Proposed Action. This does not include the 2,480 acre-feet provided to the North Fields, or an additional 510 acre-feet used to meet losses in the Timpanogos Canal associated with conveyance of the DRP supply to DIC. Conserved water would meet the needs of the replacement supply to DIC and local streams that would receive supplemental water. The remaining conserved water would be temporarily regulated in Jordanelle Reservoir and released down the Provo River to match the timing in which it would have returned to the river under baseline conditions so water supplies of downstream users would not change.

Table 3-10 shows water indirectly conserved by the Proposed Action under average conditions. About 7,000 acre-feet per year of flow passing down the Provo River in excess of instream flow requirements would be diverted from the river into the Rock Ditch/Spring Creek system. These bypass flows would help supplement the tributary flows, then return undiminished as inflow into Deer Creek Reservoir. Diversions to supplement local streams would average about 10,600 acre-feet per year. Another 10,000 acre-feet, as shown on Table 3-9, would no longer be diverted from Spring Creek by the Spring Creek, Sage Brush or Charleston irrigation companies and would maintain the target instream flows in Spring Creek and lower Lake Creek. Provo River flow not diverted by the Charleston Irrigation Company (2,000 acre-feet) would enter Deer Creek Reservoir and become part of the water supply for downstream users.

The Proposed Action would not change the water supply of lands within Heber City. The water supply would remain the same as shown in Table 3-9 for "Wasatch Heber" before and after the HCSS (see Section 3.1.2.2) is implemented.

3.2.6.3.2 Upper Strawberry River Basin. Termination of the transbasin diversions from the upper Strawberry River basin to the Daniels Creek watershed would impact the hydrology of the Strawberry River basin. Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin is described in Section 1.8.7 of Chapter 1. These activities would restore flows in the tributaries above Strawberry Reservoir to natural, unimpaired flow conditions, and increase inflow to Strawberry Reservoir. The key hydrologic impacts associated with abandonment and removal of DIC diversion facilities in the upper Strawberry River basin are:

- A change in the timing of runoff from the tributary drainages from breaching and stabilizing the dams at Daniel Reservoir No. 3 and Daniel Reservoir No. 1
- An increase in flow in streams below the existing diversion structures and above Strawberry Reservoir from termination of irrigation diversions
- A reduction in seepage along existing canals that would be dewatered.
- A change in livestock water supply source from canals to watering troughs. A 3-mile buried pipeline would be constructed to divert water from a spring to supply four livestock watering troughs. About 2 acre-feet of water would be diverted annually from the spring.

The location of the reservoirs and canals is shown on Map 1-4 in Section 1.8.7 of Chapter 1. Breaching and stabilizing Reservoirs No. 1 and No. 3 would increase spring snowmelt runoff of Mill B Canyon and the upper Strawberry River. Over a 3- to 4-week period in July, flows in Mill B Canyon and in the upper Strawberry River from Reservoirs No. 1 and No. 3 to the existing diversion structure on the Strawberry River would decrease by about 2-4 cfs, returning to natural runoff conditions.

Removal of 12 concrete diversion structures in the upper Strawberry River basin would restore the flow in Strawberry River tributaries to natural flow conditions. Flows in Bjorkman Hollow, Willow Creek and the upper Strawberry River located in the northeast portion of the drainage would increase to natural flow conditions from about May 1 to November 15 each year. Irrigation diversions normally do not occur between November 15 and May 1, so no change in flow would occur during this period. Flows in Point of Pines, Murdock Hollow, two unnamed drainages and Hobble Creek, located in the southwest portion of the drainage, would change to natural flow conditions. The canyons in the southwest portion of the valley normally flow only during the snowmelt period and do not have a measurable base flow. Irrigation diversions from these canyons presently occur only from May-July. Termination of the irrigation diversions would increase the runoff from these drainages during the

Table 3-10
Water Indirectly Conserved by the Proposed Action (WCWEP With Daniel Replacement Pipeline)

	Average (acre-feet)
Conserved Water	
Reduced Provo River Non-CUP Diversions	**13,600**
Reduced Tributary Diversions	**10,100**
Total Conserved Water	**23,700**
Provo River Bypass Flows	**7,000**
Total Available Supply	**30,700**
Conserved Water and Bypass Flow Use	
Daniel Replacement Project Supply	2,900
London Ditch Supplemental Flow[1]	600
Creamery Ditch Supplemental Flow[1]	600
Rock Ditch Supplemental Flow[1, 2]	9,400
Undiverted Spring Creek Flow[3]	10,000
Undiverted Provo River Flow	2,000
Conserved Water Released from Jordanelle to Provo River	5,200
Total Conserved Water and Bypass Flow	**30,700**

Notes:

[1] Lake Creek supplemental flow is comprised of instream outflow from Rock, London, and Creamery Ditches

[2] Rock Ditch Supplemental Flow includes supplemental flow for Spring Creek

[3] Undiverted Spring Creek Flow is used to meet target instream flow requirements for Spring Creek

May-July period. A complete record of the diversions from the Strawberry River basin from 1936 to 1991 can be found in Appendix A of the Preliminary Planning Report (CUWCD 1993a).

Table 3-11 shows the estimated average monthly increase in inflow to Strawberry Reservoir from the termination of transbasin diversions to Daniels Creek.

Total average inflow to the reservoir would increase by about 2,900 acre-feet per year, ranging from a low of 700 acre-feet during dry conditions in about 5 percent of the years, to as much as 5,400 acre-feet in wet years.

Dewatering and stabilization of the canals that divert water from the upper Strawberry River tributaries to the Daniels Creek watershed would reduce water seepage along the length of the canals. The greatest seepage losses occur along Willow Ditch. Seepage from the canals presently returns to the tributaries below the present points of diversion, and flows into Strawberry Reservoir. Termination of the tributary diversions would cause the water presently seeping from the canals to flow directly down the streams and more quickly enter Strawberry Reservoir. High- flow runoff would slightly increase and summer seepage gains to the tributaries would decrease. However, the total summer flow in the tributaries would be greater than present conditions as a result of terminating the irrigation diversions. Water would remain in the streams, causing a decrease in water consumption by water-loving plants associated with the present canal seepage. Because groundwater levels are shallow in the area, this decrease in consumption would not be significant or quantifiable. The overall increase in inflow to Strawberry Reservoir is therefore estimated as the same amount of water that has historically flowed across the basin divide — about — 2,900 acre-feet per year. No measurable changes in groundwater levels would occur in the upper Strawberry River basin. The impact of reduced canal seepage and increased tributary stream flow on wetlands is discussed in Section 3.4, Wetlands.

Table 3-11
Estimated Average Monthly Increase in Total Inflow to Strawberry Reservoir Resulting From Termination of Transbasin Diversions to Daniels Creek

Month	Total Strawberry* Reservoir Inflow (cfs)	Increase in Inflow (cfs)	Increase in Inflow (%)
January	27.7	0	0
February	20.2	0	0
March	36.2	0	0
April	303.2	0.2	0.1
May	953.2	12.2	1.3
June	684.3	20.6	3.0
July	318.3	8.5	2.7
August	137.3	3.4	2.5
September	107.3	2.3	2.1
October	252.1	1.1	0.4
November	193.1	0.2	0.1
December	33.9	0	0
Average	**255.5**	**4.0**	**1.6**

Note:
* Total inflow from all sources, including the Strawberry Aqueduct Collection System from Spanish Fork-Nephi System operation model

Construction of a pipeline and livestock watering troughs would result in consumption of water from a spring due east of the existing diversion structure on the Strawberry River in the mouth of Mill B Canyon (next to an old cabin in Section 1, T.1S., R.12W., Uintah Special Meridian). The U.S. Forest Service (USFS) estimates that about 2 acre-feet of water would be needed from the spring to provide a sufficient annual water supply. A water right exchange and application for a change in point of use would be filed by the USFS with the Utah Division of Water Rights to exchange 2 acre-feet of the potential annual increased inflow to Strawberry Reservoir for rights to divert flow from the spring, or a like amount of water from another source.

The CUWCD would acquire DIC rights to flows in the upper Strawberry River tributaries that have historically been diverted over the basin divide to the Provo River drainage. Increased inflow to Strawberry Reservoir would be regulated and, pursuant to Section 303(b) of CUPCA, "tendered . . . to the Utah Division of Wildlife Resources" and used to increase the minimum stream flow in the Strawberry River "from the base of Soldier Creek Dam to Starvation Reservoir" and "in other streams within the Uinta basin affected by the Strawberry Collection System."

The Mitigation Commission, in consultation with the Fish and Wildlife Service (FWS) will decide where to utilize the increased Strawberry Reservoir inflow for stream flow enhancement. If the increased inflow is used below Strawberry Reservoir, a portion of the water would be lost to evaporation each year. About 7 percent of the water in Strawberry Reservoir is lost to evaporation each year. About 200 acre-feet of the increased inflow to Strawberry Reservoir would be lost to evaporation, resulting in a potential increased average flow of 2,700 acre-feet per year in the Strawberry River between Strawberry and Starvation Reservoirs if all the water is used to enhance the flow of this reach.

3.2.6.3.3 Local Tributaries. Local tributaries with flow impacts include Daniels Creek and streams that would receive supplemental flows under the Proposed Action. The following subsections describe flow impacts on local tributaries.

3.2.6.3.3.1 Daniels Creek. Termination of the transbasin diversions from the upper Strawberry River basin to Daniels Creek would reduce the flow of the creek to natural flow levels. The flow of Daniels Creek upstream of the inflow from Hobble Ditch, near the Lodge Pole Campground, would not be affected because the flow in the creek upstream of this location does not include any transbasin water. Flow in the 2-mile reach of the creek from the inflow point at Hobble Ditch to McGuire Canyon would be reduced from late May to early July each year because this is the only period when water from Hobble Ditch is discharged at the summit. Flow in Daniels Creek from McGuire Canyon, where transbasin water from the Strawberry and Willow Ditch enters Daniels Creek, to the Daniel diversions from the creek in Heber Valley, would be reduced by an average of 2,900 acre-feet per year. This represents approximately a 35 percent reduction in flow at the Whiskey Springs picnic area during summer. Figure 3-2 shows the estimated Daniels Creek flow above diversions with and without the transbasin diversion supply. The reduction in flow is as great as 51 percent during late summer in an average hydrologic year.

Average creek flows in the first 1 to 2 miles of creek below the Lower Strawberry Canal Diversion could increase from about 1,290 to 3,420 acre-feet per year as a result of increased undiverted flow by DIC. The creek channel would remain dry throughout the non-snowmelt period below the Daniel Lower Pond, the same as in baseline. The majority of the undiverted water would infiltrate the creek channel and enter the groundwater basin. Presently the diverted water recharges the groundwater basin adjacent to the creek so the end destination of the water is the same whether it is diverted or not.

Average flows in lower Daniels Creek below Highway 113 would be reduced by about 92 percent, from 6,780 acre-feet to 570 acre-feet, under the Proposed Action. This decrease in flow would be caused by reduced discharge from the canals that enter lower Daniels Creek.

3.2.6.3.3.2 Local Tributaries Receiving Supplemental Flow. Table 3-12 shows the estimated flow changes that would occur in the five streams that would receive supplemental instream flow. Section 1.8.5 of Chapter 1 describes the target instream flows that would be created in Rock Ditch, London Ditch, Creamery Ditch, Spring Creek and

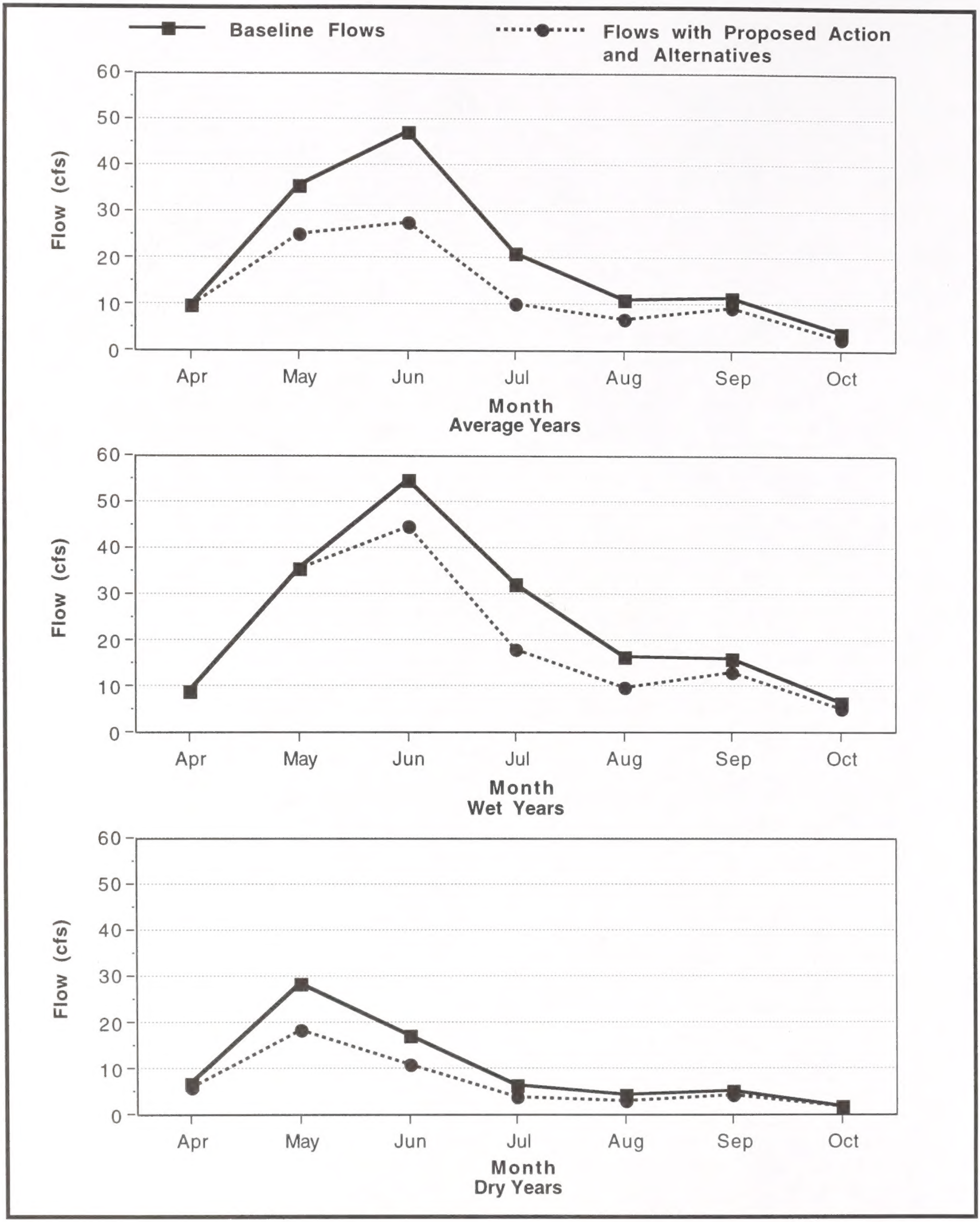


Figure 3-2
Estimated Daniels Creek Flow Above Diversions
With and Without Transbasin Supply

Table 3-12
Estimated Change in Flow in Streams Receiving Supplemental Water Under the Proposed Action

		Average Conditions												
Stream Reach		Jan (cfs)	Feb (cfs)	Mar (cfs)	Apr (cfs)	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)	Nov (cfs)	Dec (cfs)	Avg (cfs)
Rock Ditch Above Spring Creek	Baseline	1.44	2.05	3.15	3.15	11.34	8.86	6.09	1.49	1.35	2.20	2.20	2.20	3.79
	Proposed Action	10.80	10.80	10.80	12.80	14.75	14.75	14.75	14.75	14.75	12.75	10.80	10.80	12.78
	Change	9.36	8.75	7.65	9.65	3.41	5.89	8.66	13.26	13.40	10.55	8.60	8.60	8.98
London Ditch at Confluence with Spring Creek	Baseline	1.60	1.60	1.67	2.29	2.87	3.75	3.58	3.15	2.77	2.20	1.75	1.60	2.40
	Proposed Action	1.60	1.60	1.67	2.72	4.15	4.29	4.37	4.37	4.29	2.75	1.75	1.60	2.93
	Change	0.00	0.00	0.00	0.43	1.28	0.54	0.79	1.22	1.52	0.55	0.00	0.00	0.53
Creamery Ditch at Confluence with Spring Creek	Baseline	2.60	2.46	2.61	3.29	4.17	5.60	5.79	4.98	3.98	3.79	3.22	2.91	3.78
	Proposed Action	2.60	2.46	2.61	3.93	6.00	6.07	6.15	6.07	5.93	4.18	3.22	2.91	4.34
	Change	0.00	0.00	0.00	0.64	1.83	0.47	0.36	1.09	1.95	0.39	0.00	0.00	0.56
Lower Lake Creek	Baseline	0.00	0.00	0.08	0.32	1.04	2.65	0.05	0.00	0.00	0.00	0.00	0.00	0.35
	Proposed Action	4.00	4.00	4.00	5.00	6.00	6.00	6.00	6.00	6.00	5.00	4.00	4.00	5.00
	Change	4.00	4.00	3.92	4.68	4.96	3.35	5.95	6.00	6.00	5.00	4.00	4.00	4.66
Spring Creek above Charleston Upper Canal	Baseline	20.43	26.57	35.13	21.08	47.51	55.42	17.62	20.36	23.09	16.45	21.12	17.98	26.90
	Proposed Action	21.93	26.62	33.11	24.99	60.77	70.85	35.14	38.55	39.70	19.61	21.86	19.20	34.36
	Change	1.50	0.05	-2.02	3.91	13.26	15.43	17.52	18.19	16.61	3.16	0.74	1.22	7.46
Spring Creek at Confluence with Provo River	Baseline	20.43	26.57	35.21	21.40	29.58	38.58	3.61	7.42	23.09	16.45	21.12	17.98	21.79
	Proposed Action	25.93	30.62	37.11	29.80	64.88	74.90	39.51	43.26	44.58	24.61	25.86	23.20	38.69
	Change	5.50	4.05	1.90	8.40	35.30	36.32	35.90	35.84	21.49	8.16	4.74	5.22	16.90

lower Lake Creek. The source of the supplemental water supply for these streams would be bypass flows diverted from the Provo River and conserved irrigation water made available by the Proposed Action. Conserved irrigation water would be regulated in Jordanelle Reservoir and released to the streams when needed to meet target instream flows recommended by the Fishery Technical Advisory Committee established by the CUWCD during the plan formulation stage. The bypass flows would be routed from the Provo River, through the Wasatch Canal, into the tributaries, and then back to the Provo River. During critically dry years (approximately 5 percent of the years), target instream flows would be reduced by about 35 percent because conserved water supply would not be sufficient to meet the target flow.

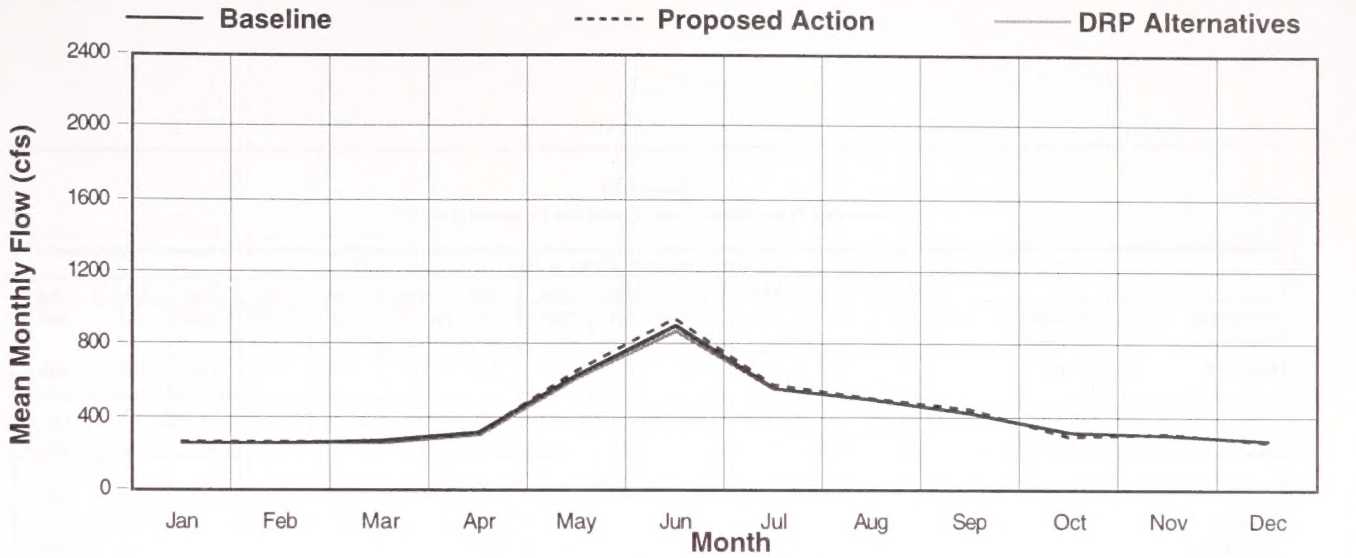
3.2.6.3.3.3 Other Local Tributaries. No impacts would occur to the flows of Lake Creek (excluding the reach below Heber City that would receive supplemental flow), Center Creek, Snake Creek and Berkenshaw creeks.

3.2.6.3.4 Provo River. Table 3-13 presents modeled Provo River flows under the Proposed Action. At the Provo River Inflow to Deer Creek Reservoir data point, flows are modeled to average 4 percent more (16 cfs) under the Proposed Action than under baseline. Under dry-year conditions, flows at this same location are modeled to be 18 cfs, or 7 percent more than baseline conditions. These flow changes would primarily be caused by reduced Heber Valley diversions under the Proposed Action and an increase in surface flow. The decrease in surface water used for irrigation causes a corresponding decrease in groundwater return flow to the Provo River system. Figure 3-3 shows the monthly average inflow to Deer Creek Reservoir from all Heber Valley sources. The increase in surface water inflow to Deer Creek Reservoir, combined with the decrease in groundwater inflow, results in a total average inflow to the reservoir from Heber Valley that is the same under the Proposed Action as under baseline conditions, although there would be small changes in average monthly inflows.

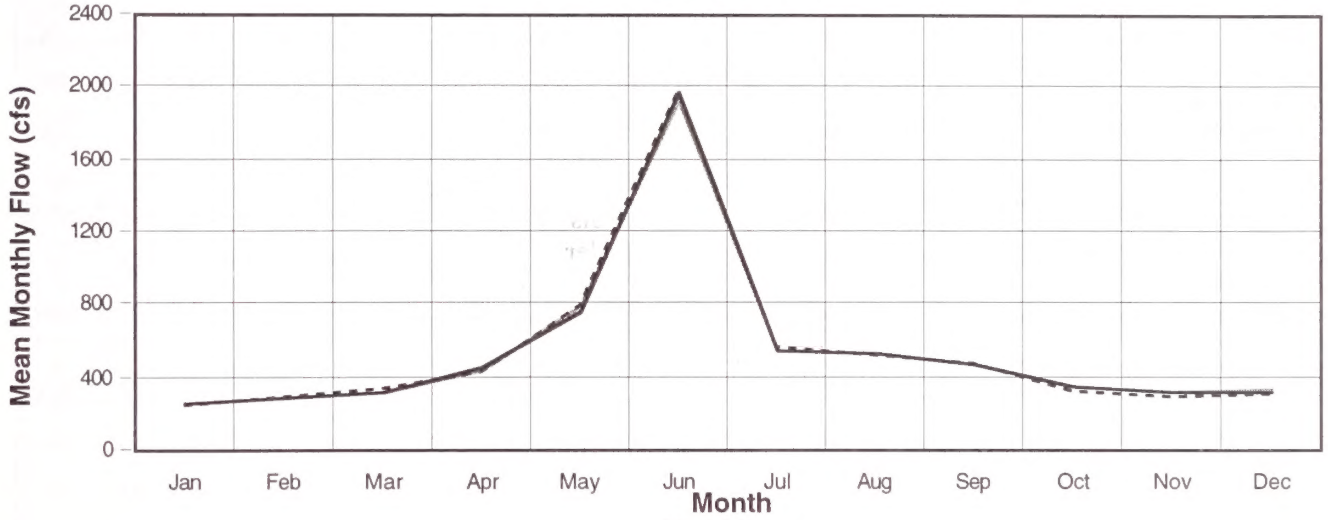
The annual average outflow from Deer Creek Reservoir is about the same under the Proposed Action as under baseline conditions. Termination of the Strawberry transbasin diversion to Daniels Creek would eliminate the return flow from this source of water in the Provo River basin. However, the decrease in diversions in Heber Valley would reduce the losses of unconsumed irrigation water from Heber Valley that is consumed by other vegetation and lost from the river system. These two factors effectively offset the impacts of each other on the overall hydrology of the river. The annual average flow at all locations along the Provo River to Utah Lake, including Provo River flows at the Provo City gage would also not change. The annual average inflow to Utah Lake is the same under the Proposed Action simulation as under baseline simulations. As stated in Section 3.2.5.5, modeled flows below Deer Creek Reservoir for baseline, the Proposed Action and the DRP alternatives do not include the 75 cfs minimum instream flow.

3.2.6.3.5 Jordanelle and Deer Creek Reservoirs. Table 3-14 shows modeled average monthly storage, elevation and surface area in Jordanelle and Deer Creek reservoirs under the Proposed Action. A comparison of modeled end-of-month storage levels in Jordanelle and Deer Creek reservoirs under the Proposed Action with baseline levels is shown in Figures 3-4 and 3-5, respectively. Under the most critical water supply conditions modeled (January 1962), the minimum storage in Jordanelle Reservoir is 18,000 acre-feet less under the Proposed Action than under baseline conditions. During the same period in the hydrologic record, the total modeled storage in Deer Creek Reservoir is 700 acre-feet less under the Proposed Action than under baseline. The total reservoir system storage (Jordanelle and Deer Creek reservoirs combined) in hydrologic month January 1962 is 32,500 acre-feet, which is 18,700 acre-feet less than total baseline storage. The minimum total system storage occurs in hydrologic month October 1961 — a total of 28,600 acre-feet, or 17,400 acre-feet less than baseline.

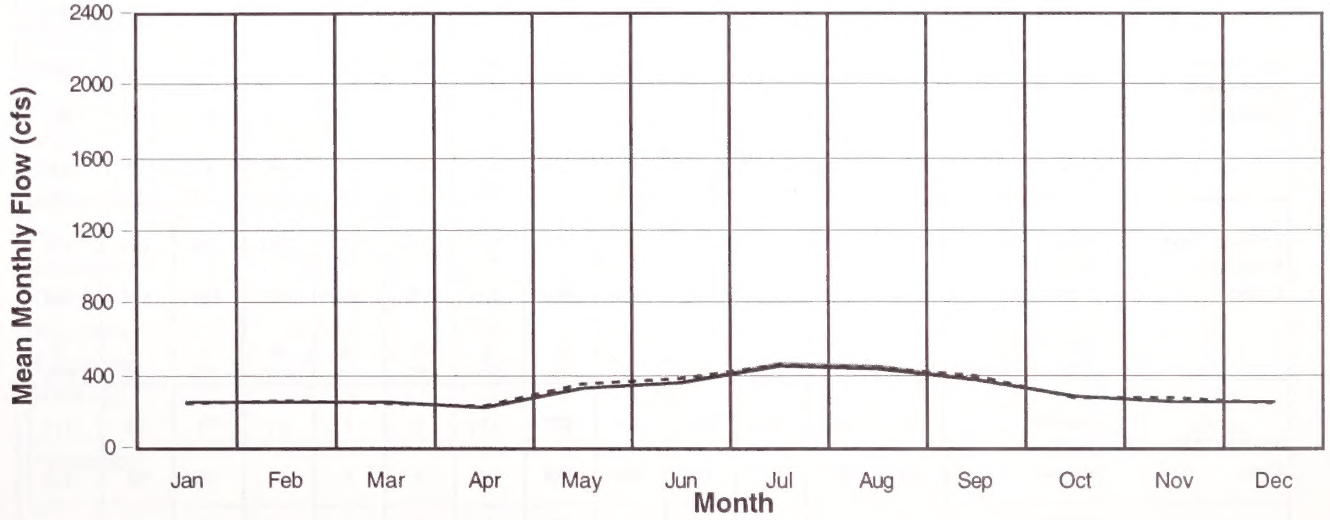
Average Jordanelle Reservoir storage is about 8,600 acre-feet (or 5 feet in elevation) less under the Proposed Action than under modeled baseline storage levels. Average Deer Creek Reservoir storage is about 1,100 acre-feet less under the Proposed Action (less than 1 foot in elevation) than under baseline. Water surface area under the Proposed Action is about 74 acres less than baseline at Jordanelle Reservoir and 15 acres less than baseline at Deer Creek Reservoir. Although average reservoir storage levels are lower, deliveries to water users downstream of Deer Creek Reservoir are not impacted.



Average Years



Wet Years



Dry Years

Figure 3-3
Modeled Total Heber Valley Inflows to Deer Creek Reservoir

Table 3-13
Modeled Provo River Flows Under the Proposed Action

		Average Monthly Flows in cfs												
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg**
Jordanelle Reservoir Releases	Baseline	128	126	128	192	727	967	628	503	345	129	143	131	**346**
	Proposed Action	136	133	137	188	665	948	638	522	357	143	149	138	**346**
	Difference	8	7	9	-4	-62	-19	10	19	12	14	6	7	**0**
	Percent Change	6%	6%	7%	-2%	-9%	-2%	2%	4%	3%	11%	4%	5%	**0%**
Below Timpanogos Canal	Baseline	129	127	129	191	677	908	574	462	324	129	143	132	**327**
	Proposed Action	136	134	138	188	647	921	582	476	337	143	150	139	**332**
	Difference	7	7	9	-3	-30	13	8	14	13	14	7	7	**5**
	Percent Change	5%	6%	7%	-2%	-4%	1%	1%	3%	4%	11%	5%	5%	**2%**
Below Valeo Diversion	Baseline	133	132	136	182	536	763	429	350	263	131	148	136	**278**
	Proposed Action	128	128	134	172	522	776	436	350	256	129	143	131	**275**
	Difference	-5	-4	-2	-10	-14	13	7	0	-7	-2	-5	-5	**-3**
	Percent Change	-4%	-3%	-1%	-5%	-3%	2%	2%	0%	-3%	-2%	-3%	-4%	**-1%**
Below River Ditch	Baseline	133	132	136	180	502	728	407	334	249	131	148	136	**268**
	Proposed Action	128	128	134	169	488	740	412	332	243	129	143	131	**265**
	Difference	-5	-4	-2	-11	-14	12	5	-2	-6	-2	-5	-5	**-3**
	Percent Change	-4%	-3%	-1%	-6%	-3%	2%	1%	-1%	-2%	-2%	-3%	-4%	**-1%**
Below Island Ditch	Baseline	143	144	148	192	517	746	426	349	265	146	160	146	**282**
	Proposed Action	137	138	146	181	502	756	429	346	257	142	154	141	**277**
	Difference	-6	-6	-2	-11	-15	10	3	-3	-8	-4	-6	-5	**-5**
	Percent Change	-4%	-4%	-1%	-6%	-3%	1%	1%	-1%	-3%	-3%	-4%	-3%	**-2%**
At Inlet of Deer Creek Reservoir	Baseline	224	226	230	267	592	823	491	430	365	259	257	232	**366**
	Proposed Action	226	230	238	271	615	873	531	463	391	253	263	230	**382**
	Difference	2	4	8	4	23	50	40	33	26	-6	6	-2	**16**
	Percent Change	1%	2%	3%	1%	4%	6%	8%	8%	7%	-2%	2%	-1%	**4%**
At Deer Creek Reservoir Outlet	Baseline	198	198	208	293	700	927	715	680	558	290	184	181	**428**
	Proposed Action	193	194	209	280	704	960	719	679	552	284	180	177	**428**
	Difference	-5	-4	1	-13	4	33	4	-1	-6	-6	-4	-4	**0**
	Percent Change	-3%	-2%	0%	-4%	1%	4%	1%	0%	-1%	-2%	-2%	-2%	**0%**
At Provo City Gage	Baseline	51	60	86	152	377	429	11	1	1	21	78	66	**111**
	Proposed Action	45	55	87	139	380	462	14	1	1	17	68	62	**111**
	Difference	-6	-5	1	-13	3	33	3	0	0	-4	-10	-4	**0**
	Percent Change	-12%	-8%	1%	-9%	1%	8%	27%	0%	0%	-19%	-13%	-6%	**0%**

Table 3-14
Modeled Average Monthly Storage, Elevation, and Surface Area in Jordanelle and Deer Creek Reservoirs Under the Proposed Action

Jordanelle Reservoir

Month	Storage* (acre-feet)	Change from Baseline* (acre-feet)	Surface Area (acres)	Change from Baseline (acres)	Water Surface Elevation (feet)	Change from Baseline (feet)
January	206,300	-10,300	2,240	-88	6,118	-7
February	206,300	-10,700	2,239	-95	6,118	-7
March	207,200	-11,200	2,243	-96	6,118	-8
April	219,300	-11,100	2,337	-94	6,124	-7
May	254,200	-6,600	2,603	-55	6,141	-3
June	269,600	-4,700	2,711	-43	6,148	-3
July	245,900	-5,400	2,548	-41	6,138	-3
August	218,000	-7,200	2,342	-61	6,125	-4
September	202,200	-8,200	2,219	-74	6,117	-5
October	201,700	-8,900	2,209	-79	6,116	-6
November	203,500	-9,400	2,222	-83	6,117	-6
December	203,500	-9,900	2,220	-88	6,117	-7
Average	**219,800**	**-8,600** **(-4%)**	**2,345**	**-75** **(-3%)**	**6,125**	**-5** **(-2%)**

*Rounded

Deer Creek Reservoir

Month	Storage* (acre-feet)	Change from Baseline* (acre-feet)	Surface Area (acres)	Change from Baseline (acres)	Water Surface Elevation (feet)	Change from Baseline (feet)
January	109,500	-1,500	2,079	-20	5,396	-1
February	114,200	-1,700	2,145	-26	5,399	-1
March	120,200	-2,000	2,230	-33	5,401	-1
April	123,700	-2,100	2,275	-30	5,403	-1
May	125,500	-1,200	2,301	-19	5,404	-1
June	125,400	-1,600	2,305	-21	5,404	-1
July	115,000	-900	2,151	-11	5,399	0
August	103,500	0	1,991	1	5,393	0
September	95,300	800	1,884	14	5,389	1
October	93,900	-700	1,865	-10	5,388	0
November	99,700	-900	1,943	-12	5,391	0
December	104,700	-1,500	2,015	-17	5,394	-1
Average	**110,900**	**-1,100** **(-1%)**	**2,099**	**-15** **(-1%)**	**5,397**	**0** **(0%)**

*Rounded

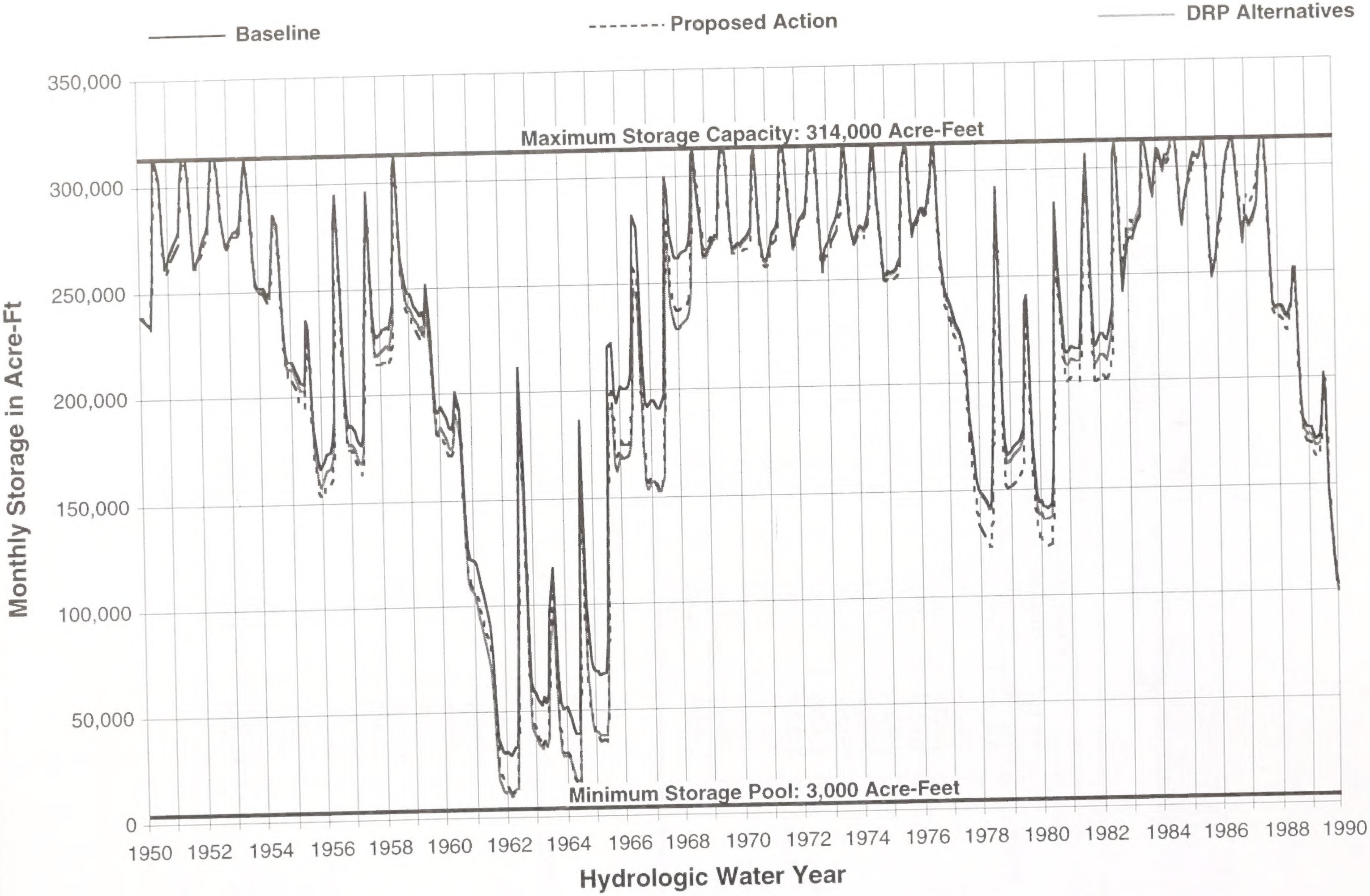


Figure 3-4
Modeled Jordanelle Reservoir Storage

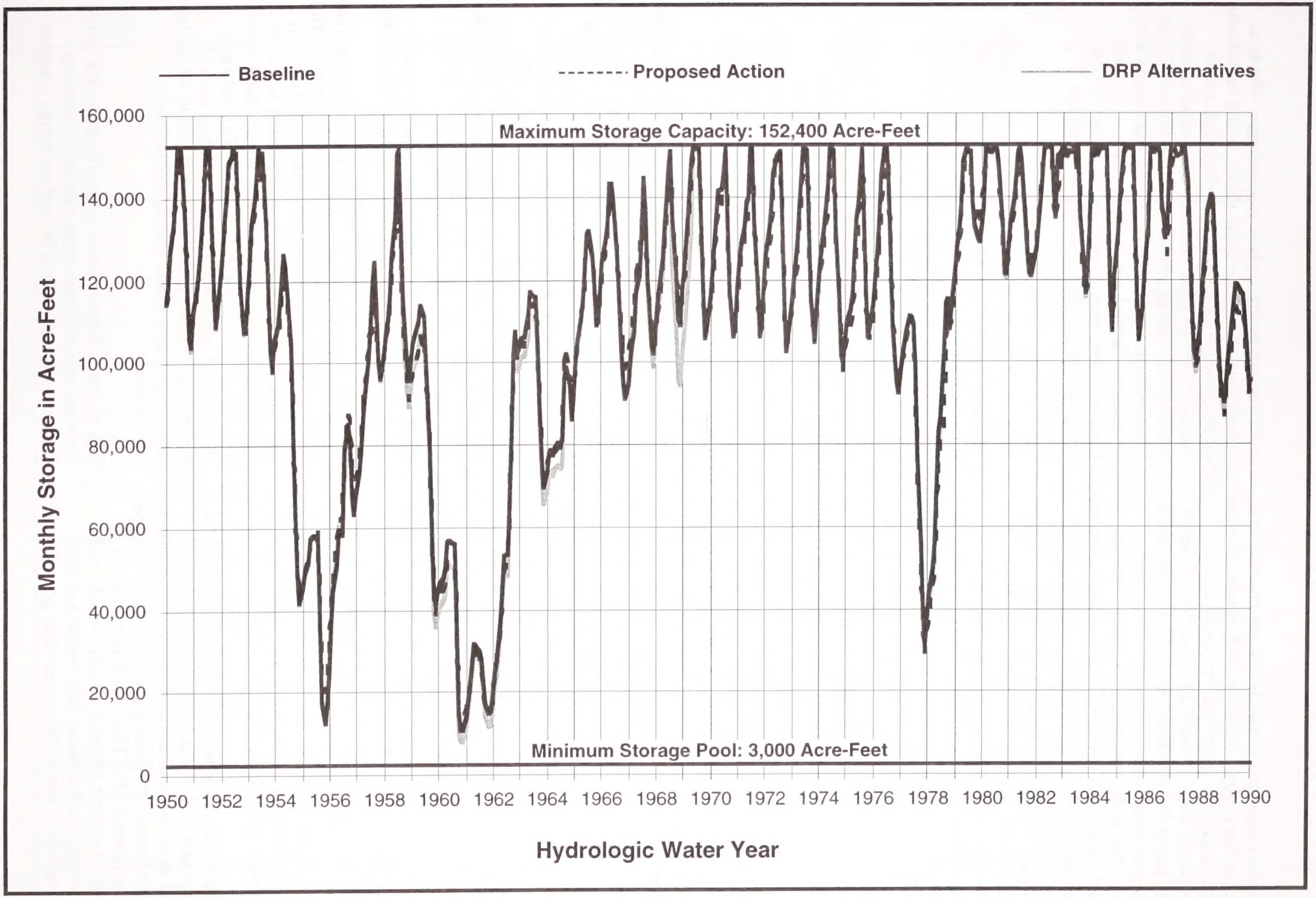


Figure 3-5
Modeled Deer Creek Reservoir Storage

The lowered average storage levels are the result of changes in the timing of storage and release of water from the reservoirs under the Proposed Action. The Proposed Action would increase the efficiency of water use in Heber Valley, thus reducing diversion requirements and conserving water in the valley. However, the ability to store conserved water in Jordanelle Reservoir is limited because the conserved water would be available during the months of high runoff and storage levels. This storage limitation along with a change in timing of return flows from the Heber Valley groundwater basin would cause the Proposed Action to lower Jordanelle Reservoir levels compared to baseline conditions. There would be an increase in flow in the Provo River between Jordanelle and Deer Creek reservoirs under the Proposed Action during the spring and early summer as compared to baseline because of a reduction in diversion from the Provo River. Compared to baseline conditions, the return flows from the Heber Valley groundwater basin under the Proposed Action would be less during the summer and fall when demands are at their highest downstream of Deer Creek Reservoir. Additional releases from Jordanelle Reservoir would be required during the summer and fall under the Proposed Action to avoid reductions in deliveries to downstream users and to meet water right storage requirements in Deer Creek Reservoir.

Under the Bonneville Unit M&I System Final Supplement to Final Environmental Statement (USBR 1987), both reservoirs were expected to be drawn down to their minimum pool levels (a combined system storage of 6,000 acre-feet) during an extended, critically dry period. Modeled Jordanelle Reservoir water levels are within the range identified in the M&I Final Supplement. Reductions in CUP agricultural deliveries would occur during critical periods to allow greater use of reservoir storage during non-critical periods.

3.2.6.3.6 Groundwater Resources. The following subsections describe impacts on groundwater resources under the Proposed Action.

3.2.6.3.6.1 Groundwater Recharge and Discharge. The Proposed Action would reduce groundwater recharge from baseline in Heber Valley by an annual average of about 20 percent, or 18,759 acre-feet per year (see Table 3-15). This would be caused by a reduction in applied irrigation water, which would reduce the amount of water that would percolate into the aquifer. About 20 percent less groundwater would return to the surface as discharge. The total groundwater discharge in the valley would be reduced on an annual average basis, but discharge would increase locally in the summer from supplemental instream flow seepage and additional Daniels Creek channel seepage. Groundwater basin discharge would be reduced throughout the valley from 1 percent (Snake Creek return flows) to 39 percent (local drains and seeps not associated with hillside outflow).

During wet years, recharge and discharge would be reduced by 20 percent on an annual average basis (19,500 acre-feet per year). Under the Proposed Action, annual dry-year discharge would be reduced to about 15,600 acre-feet.

As shown in Figure 3-3 in Section 3.2.6.3.4, total inflow to Deer Creek Reservoir is about the same under the Proposed Action as under baseline conditions. This is because the reduction in groundwater return flow is offset by a comparable increase in surface flow from streams receiving supplemental water and an increase in undiverted Provo River flow.

The annual average groundwater discharge to Spring Creek and the Upper Charleston and Sagebrush and Spring Creek canals would be about 39 percent lower under the Proposed Action than discharge to these areas under baseline conditions. The increase in discharge to these areas under baseline conditions was modeled to be about 12 percent higher than existing conditions. The decrease in discharge to these areas under the Proposed Action would thus be about 33 percent lower than existing conditions.

3.2.6.3.6.2 Groundwater Levels. The Proposed Action would lower groundwater levels in some areas of Heber Valley. The greatest change in groundwater levels, up to 60 feet lower than baseline conditions (42 feet lower than existing conditions), are expected in the southeast portion of the valley (see Map 3-5). This change would occur under the Timpanogos Irrigation Company where water levels are currently 100 to 150 feet deep. Groundwater levels in the agricultural areas north and west of Heber City, and southeast of Spring Creek, would be about 2 to 8 feet lower than under baseline conditions.

The seasonal fluctuation in groundwater levels would be more subdued than under baseline conditions because less water would be applied during summer.

Table 3-15
Modeled Groundwater Recharge and Discharge Changes Under the Proposed Action and Alternatives* Average Conditions

Category	Baseline	Proposed Action			Daniel Replacement Project With Pipeline			Daniel Replacement Project With Canal		
		Recharge/ Discharge	Change from Baseline		Recharge/ Discharge	Change from Baseline		Recharge/ Discharge	Change from Baseline	
	(ac-ft)	(ac-ft)	(ac-ft)	(%)	(ac-ft)	(ac-ft)	(%)	(ac-ft)	(ac-ft)	(%)
Groundwater Basin Recharge										
Unconsumed Ag Water and Precip.	89,749	66,336	(23,413)	-26.1%	84,921	(4,828)	-5.4%	85,024	(4,725)	-5.3%
Supplemental Instream Losses	0	2,900	2,900	0.0%	0	0	0.0%	0	0	0.0%
Daniels Creek Channel Losses	1,838	3,592	1,754	95.4%	3,592	1,754	95.4%	3,592	1,754	95.4%
Total Groundwater Recharge	91,587	72,828	(18,759)	-20.5%	88,513	(3,074)	-3.4%	88,616	(2,971)	-3.2%
Groundwater Basin Discharge										
Local Drains and Seeps	26,915	16,341	(10,574)	-39.3%	25,360	(1,555)	-5.8%	25,497	(1,418)	-5.3%
Evapotranspiration	8,053	7,316	(737)	-9.2%	7,680	(373)	-4.6%	7,647	(406)	-5.0%
Snake Creek Accretions	7,512	7,445	(67)	-0.9%	7,440	(72)	-1.0%	7,433	(79)	-1.1%
Provo River Accretions	25,351	22,844	(2,507)	-9.9%	24,488	(863)	-3.4%	24,448	(903)	-3.6%
Deer Creek Reservoir Accretions	23,917	19,237	(4,680)	-19.6%	23,723	(194)	-0.8%	23,757	(160)	-0.7%
Total Groundwater Discharge	91,748	73,183	(18,565)	-20.2%	88,691	(3,057)	-3.3%	88,782	(2,966)	-3.2%
Groundwater Basin Change in Storage	(161)	(355)	(194)		(178)	(17)		(166)	(5)	

Notes:

*Based on MODFLOW model output for baseline level of development assumptions.

( ) Denotes a negative value

Instead of a 20-foot seasonal variation, a 5-foot variation is expected. However, changes in maximum and minimum groundwater level over extended dry and wet periods would remain about the same as baseline (5 to 20 feet of variation).

The baseline groundwater gradient generally parallels the land surface. In areas where groundwater levels are near the surface, along the Provo River, water levels would not be affected by the Proposed Action. On the east side of the valley where groundwater levels are far below the surface, groundwater levels are expected to drop. The overall groundwater flow direction would not change with the lowered groundwater levels, but the gradient would be flattened somewhat. The slope of the groundwater table along the east-west line, between the Humbug Canal crossing of Highway 40 and the airport, are estimated to change from an average of 75 feet per mile under baseline conditions to 40 feet per mile under the Proposed Action.

Areas of concern for potential wetland impacts from lower groundwater levels include the North Fields Irrigation Company area, the wet meadow land along Creamery Ditch, and the areas along Spring Creek and the Provo River in the southern part of Heber Valley. Irrigation practices would not change in the North Fields Irrigation Company under the Proposed Action or alternatives. Provo River water belonging to the Spring Creek, Sage Brush and Charleston irrigation companies that was historically used in the North Fields would be routed through the Wasatch Canal under the Proposed Action and would no longer be available for the diversion in the North Fields. This water has historically helped raise the water table to the surface in the North Fields in the spring, creating wetland areas. Without this water supply, modeled groundwater levels did not rise to the ground surface each year as has historically occurred.

To avoid wetland impacts, an average of 2,480 acre-feet per year of water made available by irrigation efficiency improvements would be provided to the North Fields under the Proposed Action to maintain the water supply of the wetland areas. This would be done by contract between the CUWCD and Wasatch County Special Service Area (WCSSA).

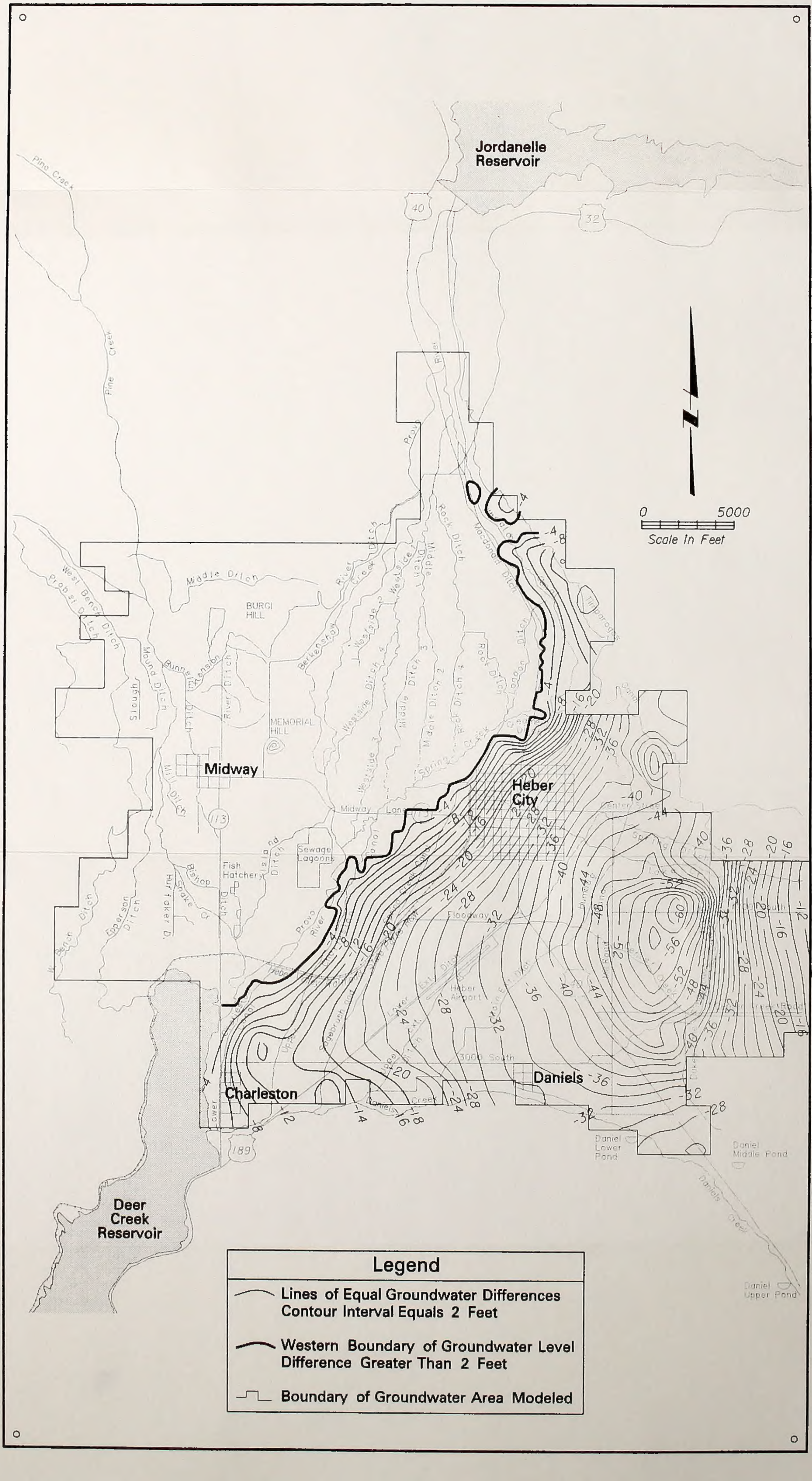
Approximately 1,920 acre-feet of this amount would offset the reduction in irrigation supply associated with rerouting Provo River water through the Wasatch Canal. This water belongs to irrigation companies that divert from Spring Creek and is presently recharged in the North Fields before draining to Spring Creek. An agreement between the CUWCD, Wasatch County Special Services Area (WCSSA) and North Field Irrigation Company would restrict use of the replacement water to the same timing and location where it is presently used. Groundwater levels would decline in the North Fields and adverse impacts would occur to wetland areas without this replacement supply, based on groundwater modeling.

The remaining 560 acre-feet would be available to the lands on the MacDonald Ditch. The MacDonald Ditch is the eastern-most irrigation ditch of the North Fields Irrigation Company. It follows Highway 40, crossing the highway at several locations. Much of the land along the MacDonald Ditch is wetlands that are sub-irrigated by seepage from uphill land served by the Wasatch and Timpanogos Canals that would be converted to sprinklers under the Proposed Action. The amount of 560 acre-feet is the computed decrease in groundwater recharge that would be associated with the conversion of the uphill lands to sprinkler irrigation. The irrigation of this amount of water by the MacDonald Ditch would offset reductions in seepage from uphill areas by the Proposed Action. Therefore, no change in groundwater levels is expected along the MacDonald Ditch.

Increased seepage losses along Rock Ditch, associated with the supplemental instream flow, also would help maintain shallow groundwater levels in the North Fields. The supplemental instream supply includes a channel loss allowance of 5 cfs during summer and 3 cfs during winter.

Map 3-5 shows the approximate location of the 2-foot decline in water levels from baseline levels. This line approximates the western extent of groundwater level changes. The wetlands discussion in Section 3.4 of Chapter 3 provides more information on how the groundwater analysis results were used to define potential wetlands impacts.

3.2.6.3.6.3 ***Wells and Springs.*** The wells and springs that could be impacted by the Proposed Action are on the east side of the valley in areas that would be converted to sprinkler irrigation. Several springs and wells exist in the west part of the valley, but groundwater levels are not expected to change in that area, so neither the springs nor wells would be affected. Springs in Daniels Canyon are



Map 3-5
Modeled Differences in Groundwater
Elevations Between Baseline and
Proposed Action Under Average Conditions

associated with shallow fractures in surrounding bedrock, and would not be affected by a lowering of groundwater levels in the valley. East-side springs that could be affected include London and Hatch springs. The Proposed Action is not expected to affect groundwater levels near London Spring, so it would not impact the spring. Groundwater levels and flows at Hatch Spring, at the head of Creamery Ditch, may be lowered by the Proposed Action. However, under the Proposed Action, the supplemental flows would be added to Creamery Ditch at Hatch Spring to maintain target outflows from the ditch. The supplemental flows would offset the potential reduction in flow from the spring, thus avoiding adverse impacts.

Approximately 400 wells are located in the potentially impacted area. Existing water levels were reviewed in relation to the depths of these wells and the intervals where groundwater was intercepted. These wells, predominately 6 or 8 inches in diameter, are used for single-family domestic and livestock watering purposes. The depth to water under baseline conditions is 200 to 250 feet, although standing water in some wells is only 20 to 80 feet below the surface. Depth of the wells ranges from 150 to 500 feet (UDNR 1991). Water levels were modeled to be 40 to 60 feet lower than baseline levels (25 to 40 feet lower than existing levels) in the area of greatest change southeast of Heber City as shown on Map 3-5. Shallow wells may be adversely affected as groundwater levels approach the bottom of the well and pumping lifts increase.

To evaluate potential impacts on the availability of water in Heber Valley wells, the minimum modeled groundwater levels during the study period (hydrologic month March 1962) were compared with existing groundwater depths and well depths. Some wells could become inoperable during critically dry years because of lowered groundwater levels under the Proposed Action. This would be a significant and adverse impact. The exact number and location of the impacted wells would be determined by a groundwater monitoring program that would help determine which wells would be deepened or re-drilled, using money from a mitigation reserve fund.

3.2.6.3.7 Impact Summary. Streamflows in tributaries in the Strawberry River basin would return to natural flow conditions. Inflow to Strawberry Reservoir would increase by an annual average of 2,900 acre-feet per year and stream flow in Daniels Creek above irrigation diversions would decrease by approximately 2,900 acre-feet per year.

Average Jordanelle Reservoir storage levels would be approximately 8,600 acre-feet less than baseline storage levels and Deer Creek Reservoir storage levels would be 1,100 acre-feet less than baseline levels. CUP and non-CUP deliveries to water users downstream of Deer Creek Reservoir would not change from baseline amounts. Although Provo River flows between Jordanelle and Deer Creek reservoirs would change slightly because of the changes in diversions and return flows, average annual river flows below Deer Creek Reservoir would not change. Supplemental flows placed in five Heber Valley streams and ditches would increase flows in these streams over baseline conditions.

The Proposed Action would reduce groundwater levels in Heber Valley. The reduction in water levels would range from approximately 2 feet west of Heber City and up to 60 feet lower than baseline levels in the area under the Timpanogos Irrigation Company. Groundwater levels west of the Provo River would not be affected. Flows from Hatch Spring may be reduced slightly, however the majority of the flows in springs would not be affected. The supplemental flows added to Creamery Ditch immediately below Hatch Spring would offset reductions in flow from the Spring to the Ditch. Groundwater discharge to Spring Creek and the Upper Charleston and Spring Creek/Sagebrush canals would be approximately 40 percent lower under the Proposed Action than it would be under baseline conditions. Flows in Spring Creek would be greater than baseline because of increased inflow from ditches upstream receiving supplemental flow.

Some wells could become inoperable during critically dry years as a result of lowered groundwater levels under the Proposed Action. A groundwater monitoring program would be implemented to determine wells that would be impacted and a mitigation reserve fund would be established to deepen impacted wells or provide alternative water supplies.

Increased depth to water would result in increased energy use to pump water. Increased energy use is discussed in Section 3.9 Mineral and Energy Resources.

3.2.6.4 Daniel Replacement Project With Pipeline Alternative

3.2.6.4.1 Water Supply Availability. The water supply source under this alternative would be CUP agricultural water in Jordanelle Reservoir. An average of 2,900 acre-feet of CUP water would be delivered to DIC through a pipeline. CUP agricultural water available for contracting in Heber Valley would therefore be reduced from an annual average of 12,100 acre-feet to 9,200 acre-feet, a 24 percent reduction. The annual Heber Valley irrigation diversion requirement would not change from baseline because no changes would occur in irrigation methods. Table 3-9 in Section 3.2.6.3.1 shows the changes in shortages that would occur in Heber Valley compared to baseline conditions. Average shortages would increase in all irrigation companies except DIC. Average annual shortages would increase from about 3,280 acre-feet under baseline conditions to about 4,190 acre-feet, a 28 percent increase. Annual shortages during dry years under this alternative would increase by about 2 percent compared to baseline conditions. Average annual shortages would be approximately 5.9 percent of the total annual diversion requirement, an increase of 1.2 percent.

All CUP M&I deliveries would be the same under this alternative as they would be under baseline conditions. Other diversions from the Provo River system below Deer Creek Reservoir would not be affected, and no impacts to water supply wells in Heber Valley would occur. Baseline diversion quantities below Deer Creek Reservoir would be maintained by drawing on storage in Jordanelle Reservoir during average and dry years, and refilling the storage with reduced releases during wet years.

3.2.6.4.2 Upper Strawberry River Basin. The hydrologic impacts of this alternative in the upper Strawberry River basin would be the same as described for the Proposed Action in Section 3.2.6.3.2.

3.2.6.4.3 Local Tributaries. The following subsections describe impacts on local tributaries including Daniels Creek and other Heber Valley streams.

3.2.6.4.3.1 Daniels Creek. Daniels Creek flows above and immediately below the irrigation diversions would be the same as described for the Proposed Action in Section 3.2.6.3.3. Daniels Creek inflow to Deer Creek Reservoir, which is comprised mostly of drainage from canals and snowmelt runoff, would be essentially the same as baseline inflow because this alternative would not cause major reductions in drainage from the canals that enter lower Daniels Creek. The average inflow from Daniels Creek would decrease by about 490 acre-feet per year.

3.2.6.4.3.2 Other Local Tributaries. No supplemental instream flows would be delivered under this alternative. Flows in Spring Creek were modeled to be reduced by about 2 percent. Flow gains along Snake Creek, and therefore flows in Snake Creek, were modeled to be reduced by less than 1 percent. Flow in Rock Ditch (an irrigation ditch) would be reduced during late summer as a result of reduced CUP water deliveries to the North Fields Irrigation Company.

3.2.6.4.4 Provo River. Table 3-16 summarizes changes in flows along the Provo River under this alternative. Flows would decline because of a reduction in return flows to the river associated with reduced CUP agricultural water deliveries and elimination of the transbasin supply entering the basin from the Strawberry River drainage. The greatest reduction in average flow is estimated to occur downstream of Deer Creek Reservoir during the April-June high runoff period. The minimum instream flow requirements along the river would not be impacted.

Provo River flow below Deer Creek Reservoir to the Olmstead Diversion would be reduced by an average of 3 cfs, or 1 percent of the total. This is because the DRP With Pipeline Alternative would not improve water use efficiency in Heber Valley, would reduce the amount of water entering the Provo River basin by eliminating the transbasin diversion, and would maintain baseline diversions by water users below Deer Creek Reservoir. Therefore, less water would be in the river below the last downstream water user diversion (the diversion immediately upstream of the Provo City gage). The average reduction in flow at the Provo City gage, which represents the inflow to Utah Lake, would average about 3 cfs, or 3 percent of the total average flow at this location. Dry-year flows below Deer Creek Reservoir would not change.

3.2.6.4.5 Jordanelle and Deer Creek Reservoirs. Table 3-17 shows modeled average

Table 3-16
Modeled Provo River Flows Under the DRP With Pipeline Alternative

		Average Monthly Flows in cfs												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Jordanelle Reservoir Releases	Baseline	128	126	128	192	727	967	628	503	345	129	143	131	**346**
	DRP with Pipeline	129	126	128	192	714	947	641	513	351	129	144	133	**346**
	Difference	1	0	0	0	-13	-20	13	10	6	0	1	2	**0**
	Percent Change	1%	0%	0%	0%	-2%	-2%	2%	2%	2%	0%	1%	2%	**0%**
Below Timpanogos Canal	Baseline	129	127	129	191	677	908	574	462	324	129	143	132	**327**
	DRP with Pipeline	130	127	128	190	664	884	568	463	331	129	145	134	**324**
	Difference	1	0	-1	-1	-13	-24	-6	1	7	0	2	2	**-3**
	Percent Change	1%	0%	-1%	-1%	-2%	-3%	-1%	0%	2%	0%	1%	2%	**-1%**
Below Valeo Diversion	Baseline	133	132	136	182	536	763	429	350	263	131	148	136	**278**
	DRP with Pipeline	134	132	135	182	522	740	436	362	270	131	149	138	**278**
	Difference	1	0	-1	0	-14	-23	7	12	7	0	1	2	**0**
	Percent Change	1%	0%	-1%	0%	-3%	-3%	2%	3%	3%	0%	1%	1%	**0%**
Below River Ditch	Baseline	133	132	136	180	502	728	407	334	249	131	148	136	**268**
	DRP with Pipeline	134	132	135	180	488	704	415	347	257	131	149	138	**268**
	Difference	1	0	-1	0	-14	-24	8	13	8	0	1	2	**0**
	Percent Change	1%	0%	-1%	0%	-3%	-3%	2%	4%	3%	0%	1%	1%	**0%**
Below Island Ditch	Baseline	143	144	148	192	517	746	426	349	265	146	160	146	**282**
	DRP with Pipeline	144	143	148	192	503	722	435	361	272	145	161	148	**281**
	Difference	1	-1	0	0	-14	-24	9	12	7	-1	1	2	**-1**
	Percent Change	1%	-1%	0%	0%	-3%	-3%	2%	3%	3%	-1%	1%	1%	**0%**
At Inlet of Deer Creek Reservoir	Baseline	224	226	230	267	592	823	491	430	365	259	257	232	**366**
	DRP with Pipeline	224	225	229	266	578	799	502	439	368	257	257	233	**365**
	Difference	0	-1	-1	-1	-14	-24	11	9	3	-2	0	1	**-1**
	Percent Change	0%	0%	0%	0%	-2%	-3%	2%	2%	1%	-1%	0%	0%	**0%**
At Deer Creek Reservoir Outlet	Baseline	198	198	208	293	700	927	715	680	558	290	184	181	**428**
	DRP with Pipeline	199	198	207	280	692	913	714	679	557	287	184	182	**424**
	Difference	1	0	-1	-13	-8	-14	-1	-1	-1	-3	0	1	**-4**
	Percent Change	1%	0%	0%	-4%	-1%	-2%	0%	0%	0%	-1%	0%	1%	**-1%**
At Provo City Gage	Baseline	51	60	86	152	377	429	11	1	1	21	78	66	**111**
	DRP with Pipeline	51	59	85	139	369	415	11	1	1	18	78	66	**108**
	Difference	0	-1	-1	-13	-8	-14	0	0	0	-3	0	0	**-3**
	Percent Change	0%	-2%	-1%	-9%	-2%	-3%	0%	0%	0%	-14%	0%	0%	**-3%**

Table 3-17
Modeled Average Monthly Storage, Elevation, and Surface Area in Jordanelle and Deer Creek Reservoirs Under the DRP With Pipeline Alternative

Jordanelle Reservoir

Month	Storage (acre-feet)	Change from Baseline (acre-feet)	Surface Area (acres)	Change from Baseline (acres)	Water Surface Elevation (feet)	Change from Baseline (feet)
January	209,000	-7,600	2,258	-71	6,119	-6
February	209,400	-7,600	2,260	-74	6,119	-6
March	210,800	-7,600	2,267	-73	6,119	-6
April	222,700	-7,700	2,363	-68	6,126	-5
May	254,100	-6,700	2,606	-52	6,142	-3
June	268,600	-5,700	2,712	-42	6,148	-3
July	244,800	-6,500	2,537	-52	6,137	-3
August	218,200	-7,000	2,343	-61	6,125	-4
September	203,000	-7,400	2,223	-69	6,117	-5
October	203,300	-7,300	2,219	-69	6,117	-6
November	205,500	-7,400	2,233	-72	6,118	-6
December	205,800	-7,600	2,236	-72	6,118	-6
Average	**221,300**	**-7,100** (-3%)	**2,355**	**-65** (-3%)	**6,125**	**-5** (-2%)

Deer Creek Reservoir

Month	Storage (acre-feet)	Change from Baseline (acre-feet)	Surface Area (acres)	Change from Baseline (acres)	Water Surface Elevation (feet)	Change from Baseline (feet)
January	109,400	-1,600	2,076	-23	5,396	-1
February	114,300	-1,600	2,147	-24	5,398	-1
March	120,500	-1,700	2,237	-26	5,402	-1
April	124,200	-1,600	2,285	-20	5,403	-1
May	125,000	-1,700	2,299	-21	5,403	-1
June	124,500	-2,500	2,293	-33	5,403	-1
July	113,900	-2,000	2,134	-27	5,399	-1
August	102,100	-1,400	1,971	-19	5,392	-1
September	93,400	-1,100	1,857	-14	5,388	-1
October	93,100	-1,500	1,852	-22	5,387	-1
November	99,100	-1,500	1,933	-22	5,391	-1
December	104,700	-1,500	2,012	-20	5,394	-1
Average	**110,400**	**-1,600** (-1%)	**2,091**	**-22** (-1%)	**5,396**	**-1** (-1%)

monthly storage, elevation and surface area in Jordanelle and Deer Creek reservoirs under the DRP With Pipeline Alternative. Figures 3-4 and 3-5 in Section 3.2.6.3.5 compare modeled end-of-month storage levels in Jordanelle and Deer Creek reservoirs under this alternative with baseline levels. Average total inflow and outflow to Deer Creek Reservoir would be reduced an average annual 3 cfs compared to baseline conditions. Total annual average inflow from Heber Valley would be reduced from 419 cfs to 416 cfs.

During the period of greatest reservoir drawdown modeled (hydrologic month January 1962), the minimum storage in Jordanelle Reservoir is 19,200 acre-feet less under the DRP With Pipeline Alternative than under baseline conditions. At the same time, the total modeled storage in Deer Creek Reservoir is 3,600 acre-feet less than under baseline conditions. The total combined reservoir system storage in hydrologic month January 1962 is 29,600 acre-feet, which is 21,000 acre-feet less than under baseline conditions. Minimum total system storage of 20,500 acre-feet (Jordanelle and Deer Creek reservoirs combined) occurs in hydrologic month September 1961. Minimum total system storage is 22,800 acre-feet less than under baseline conditions.

Average Jordanelle Reservoir storage is about 7,100 acre-feet less (5 feet lower in elevation) under this alternative than the modeled baseline storage levels. Deer Creek Reservoir average storage is about 1,600 acre-feet (1 foot elevation) less under this alternative than under baseline conditions. Water surface area is about 64 acres less than baseline at Jordanelle Reservoir and 23 acres less than baseline at Deer Creek Reservoir.

3.2.6.4.6 Groundwater Resources. The following subsections describe impacts on groundwater resources under the DRP With Pipeline Alternative.

3.2.6.4.6.1. Groundwater Recharge and Discharge. Table 3-15 in Section 3.2.6.3.6.1 shows that the DRP With Pipeline Alternative would slightly reduce the average annual groundwater recharge in Heber Valley by about 3 percent, or 3,070 acre-feet per year. This would result from a decrease in CUP irrigation water applied in Heber Valley. The total annual groundwater discharge from Heber Valley also would be reduced by an average of approximately 3 percent per year. The discharge is roughly equivalent to the recharge on an average annual basis and, like baseline discharge, varies on a monthly basis.

In dry years, total annual groundwater recharge and discharge would be reduced by an average of approximately 2 percent.

3.2.6.4.6.2 Groundwater Levels. The DRP With Pipeline Alternative would cause minor impacts in groundwater levels in the eastern portion of Heber Valley, under the Timpanogos, Lake and Center Creek irrigation companies as a result of reduced application of CUP agricultural water. Groundwater levels would be no more than approximately 5 feet lower than baseline levels.

Groundwater levels would continue to fluctuate by 15 feet during the year and 40 feet from wet to dry periods. The impact caused by this alternative would be a lowering of the water levels by 2 to 5 feet at all times at the maximum points under the Timpanogos, Lake and Center Creek irrigation companies, which are areas with groundwater levels well below the ground surface.

3.2.6.4.6.3 Wells and Springs. The groundwater level impacts associated with this alternative would be relatively small, approximately 5 feet lower than baseline levels. Therefore, no significant water level impacts would occur in wells under this alternative. Furthermore, water levels under this alternative would be approximately 10 feet higher than existing water levels. This is because baseline water levels would be approximately 15 feet higher than existing levels.

This alternative would not affect the flow of springs in Heber Valley. Groundwater discharge to Spring Creek is modeled to be approximately 4 percent less than baseline as a result of lowered groundwater levels.

3.2.6.4.7 Impact Summary. Streamflows in tributaries in the Strawberry River basin would return to natural flow conditions. Inflow to Strawberry Reservoir would increase by an average annual 2,900 acre-feet per year and stream flow in Daniels Creek above irrigation diversions would decrease by approximately 2,900 acre-feet per year. The amount of CUP irrigation water available to irrigators in Heber Valley would be reduced by 2,900 acre-feet from an average of 12,100 acre-feet per year to an average of 9,200 acre-feet per year. Decreased availability of CUP agricultural water would increase average annual irrigation shortages from approximately 3,280 acre-feet per year to approximately 4,190 acre-feet per year. No changes would occur to municipal and industrial water users above Deer Creek Reservoir or any type of water users below Deer Creek Reservoir.

Water storage levels in Jordanelle and Deer Creek reservoirs would be reduced as compared to baseline and Provo River flows below Deer Creek Reservoir would be reduced by an average of 3 cfs.

This alternative would reduce the total annual groundwater recharge in Heber Valley by approximately 3 percent on an average basis. Groundwater levels would likely be approximately 5 feet lower than baseline levels under the Timpanogos, Lake and Center Creek irrigation companies. No wells or springs would be impacted.

3.2.6.5 Daniel Replacement Project With Canal Alternative

3.2.6.5.1 Water Supply Availability. An annual average of about 3,410 acre-feet of water would be needed to provide the replacement supply to DIC, which means less water would be available for contracting to other irrigation companies in Heber Valley. About 15 percent of the DRP supply would be lost to seepage in the Timpanogos Canal. An additional 510 acre-feet of CUP agricultural water per year (2,900 acre-feet delivered, plus 510 acre-feet in losses for a total of 3,410 acre-feet) would be subtracted from the CUP agricultural supply available for contracting to WCSSA. This would result in an average CUP agricultural supply of about 8,690 acre-feet per year. Table 3-9 in Section 3.2.6.3.1 shows annual shortages would increase by about 40 percent compared to average shortages under baseline conditions. The average annual shortages under this alternative would be 6.5 percent of the total annual diversion requirement, an increase of 1.8 percent.

CUP M&I deliveries in Heber Valley and all diversions from the Provo River system below Deer Creek Reservoir would not be affected by this alternative. No impacts to water availability from wells would occur.

3.2.6.5.2 Upper Strawberry River Basin. The hydrologic impacts of this alternative in the Strawberry River basin would be the same as described for the Proposed Action in Section 3.2.6.3.2.

3.2.6.5.3 Local Tributaries. Impacts of the DRP With Canal Alternative on flows in Daniels Creek and other local tributaries would be the same as described in Section 3.2.6.4.3.

3.2.6.5.4 Provo River. Provo River stream flows at all locations under this alternative would be nearly identical to flows described for the DRP With Pipeline Alternative in Section 3.2.6.4.4. Modeled Provo River flows under the DRP With Canal Alternative are presented in Table 3-18.

3.2.6.5.5 Jordanelle and Deer Creek Reservoirs. Table 3-19 shows modeled average monthly storage, elevation and surface area in Jordanelle and Deer Creek reservoirs under the DRP With Canal Alternative. A comparison of modeled end-of-month storage levels in Jordanelle and Deer Creek reservoirs under this alternative with baseline levels is shown in Figures 3-4 and 3-5, respectively. Reservoir storage, water surface elevation and surface area would be nearly identical under this alternative to the results described for the DRP With Pipeline Alternative in Section 3.2.6.4.5. Total inflow and outflow from Deer Creek Reservoir would be reduced an average of 3 cfs compared to baseline conditions.

3.2.6.5.6 Groundwater Resources. The following subsections describe impacts on groundwater resources under the DRP With Canal Alternative.

3.2.6.5.6.1 Groundwater Recharge and Discharge. Groundwater recharge and discharge impacts under the DRP With Canal Alternative would essentially be the same as those caused by the DRP With Pipeline Alternative. The annual average recharge and discharge under this alternative would be about 2 percent lower than under baseline conditions.

3.2.6.5.6.2 Groundwater Levels. The DRP With Canal Alternative would not cause a significant impact in groundwater levels. A 5-foot drop in groundwater levels would likely occur in the southeastern portion of Heber Valley compared to baseline conditions.

3.2.6.5.6.3 Wells and Springs. Wells and springs would not have measurable impacts under this

Table 3-18
Modeled Provo River Flows Under the DRP With Canal Alternative

		Average Monthly Flows in cfs												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Jordanelle Reservoir Releases	Baseline	128	126	128	192	727	967	628	503	345	129	143	131	**346**
	DRP with Canal	130	126	128	192	716	947	642	512	352	127	144	133	**346**
	Difference	2	0	0	0	-11	-20	14	9	7	-2	1	2	**0**
	Percent Change	2%	0%	0%	0%	-2%	-2%	2%	2%	2%	-2%	1%	2%	**0%**
Below Timpanogos Canal	Baseline	129	127	129	191	677	908	574	462	324	129	143	132	**327**
	DRP with Canal	130	127	128	190	664	884	568	463	331	128	144	133	**324**
	Difference	1	0	-1	-1	-13	-24	-6	1	7	-1	1	1	**-3**
	Percent Change	1%	0%	-1%	-1%	-2%	-3%	-1%	0%	2%	-1%	1%	1%	**-1%**
Below Valeo Diversion	Baseline	133	132	136	182	536	763	429	350	263	131	148	136	**278**
	DRP with Canal	135	132	135	182	523	739	435	363	271	130	149	137	**278**
	Difference	2	0	-1	0	-13	-24	6	13	8	-1	1	1	**0**
	Percent Change	2%	0%	-1%	0%	-2%	-3%	1%	4%	3%	-1%	1%	1%	**0%**
Below River Ditch	Baseline	133	132	136	180	502	728	407	334	249	131	148	136	**268**
	DRP with Canal	135	132	135	180	489	704	415	347	258	130	149	137	**268**
	Difference	2	0	-1	0	-13	-24	8	13	9	-1	1	1	**0**
	Percent Change	2%	0%	-1%	0%	-3%	-3%	2%	4%	4%	-1%	1%	1%	**0%**
Below Island Ditch	Baseline	143	144	148	192	517	746	426	349	265	146	160	146	**282**
	DRP with Canal	145	143	148	192	504	722	434	361	273	144	161	148	**281**
	Difference	2	-1	0	0	-13	-24	8	12	8	-2	1	2	**-1**
	Percent Change	1%	-1%	0%	0%	-3%	-3%	2%	3%	3%	-1%	1%	1%	**0%**
At Inlet of Deer Creek Reservoir	Baseline	224	226	230	267	592	823	491	430	365	259	257	232	**366**
	DRP with Canal	224	225	229	266	579	799	502	439	368	256	257	232	**365**
	Difference	0	-1	-1	-1	-13	-24	11	9	3	-3	0	0	**-1**
	Percent Change	0%	0%	0%	0%	-2%	-3%	2%	2%	1%	-1%	0%	0%	**0%**
At Deer Creek Reservoir Outlet	Baseline	198	198	208	293	700	927	715	680	558	290	184	181	**428**
	DRP with Canal	198	198	207	280	693	914	714	679	557	287	184	182	**425**
	Difference	0	0	-1	-13	-7	-13	-1	-1	-1	-3	0	1	**-3**
	Percent Change	0%	0%	0%	-4%	-1%	-1%	0%	0%	0%	-1%	0%	1%	**-1%**
At Provo City Gage	Baseline	51	60	86	152	377	429	11	1	1	21	78	66	**111**
	DRP with Canal	51	60	85	139	370	416	11	1	1	19	78	66	**108**
	Difference	0	0	-1	-13	-7	-13	0	0	0	-2	0	0	**-3**
	Percent Change	0%	0%	-1%	-9%	-2%	-3%	0%	0%	0%	-10%	0%	0%	**-3%**

Table 3-19
Modeled Average Monthly Storage, Elevation, and Surface Area in Jordanelle and Deer Creek Reservoirs Under the DRP With Canal Alternative

Jordanelle Reservoir

Month	Storage (acre-feet)	Change from Baseline (acre-feet)	Surface Area (acres)	Change from Baseline (acres)	Water Surface Elevation (feet)	Change from Baseline (feet)
January	209,300	-7,300	2,259	-70	6,119	-6
February	209,700	-7,300	2,264	-70	6,119	-6
March	211,200	-7,200	2,270	-70	6,119	-6
April	223,100	-7,300	2,365	-67	6,126	-5
May	254,400	-6,400	2,607	-50	6,142	-3
June	268,900	-5,400	2,713	-40	6,148	-3
July	245,100	-6,200	2,541	-48	6,138	-3
August	218,400	-6,800	2,343	-60	6,125	-4
September	203,300	-7,100	2,228	-65	6,118	-5
October	203,600	-7,000	2,224	-64	6,117	-5
November	205,800	-7,100	2,238	-67	6,118	-5
December	206,200	-7,200	2,238	-70	6,118	-6
Average	**221,600**	**-6,800** **(-3%)**	**2,358**	**-62** **(-3%)**	**6,126**	**-5** **(-2%)**

Deer Creek Reservoir

Month	Storage (acre-feet)	Change from Baseline (acre-feet)	Surface Area (acres)	Change from Baseline (acres)	Water Surface Elevation (feet)	Change from Baseline (feet)
January	109,400	-1,600	2,077	-22	5,396	-1
February	114,300	-1,600	2,147	-24	5,398	-1
March	120,400	-1,800	2,237	-26	5,402	-1
April	124,300	-1,500	2,286	-19	5,403	-1
May	125,100	-1,600	2,301	-20	5,403	-1
June	124,500	-2,500	2,294	-32	5,403	-1
July	114,000	-1,900	2,135	-26	5,399	-1
August	102,200	-1,300	1,971	-19	5,392	-1
September	93,500	-1,000	1,857	-13	5,388	-1
October	93,100	-1,500	1,853	-22	5,387	-1
November	99,000	-1,600	1,934	-21	5,391	-1
December	104,600	-1,600	2,012	-20	5,394	-1
Average	**110,400**	**-1,600** **(-1%)**	**2,092**	**-22** **(-1%)**	**5,396**	**-1** **(-1%)**

alternative for the same reasons described in Section 3.2.6.4.6.3.

3.2.6.5.7 Impact Summary. Surface water and groundwater impacts of this alternative would be nearly identical to the impacts of the DRP With Pipeline Alternative summarized in Section 3.2.6.4.7.

3.2.6.6 No Action Alternative

The No Action Alternative would have no impacts on water resources. Baseline water resource conditions described in Section 3.2.5, Affected Environment (Baseline Conditions), would occur.

3.3 Water Quality

3.3.1 Introduction

The water quality analysis addresses potential impacts on water quality from the construction, operation and maintenance of the Proposed Action and DRP alternatives. The information and analysis documented in this section was summarized from the Draft Water Quality Technical Report (CUWCD 1996e), which is available from CUWCD upon request. In addition, analysis methods are summarized in Appendix B, Section B.2.2. This section addresses the following impact topics:

- Groundwater quality
- Water quality in affected canals and streams
- Water quality in Deer Creek Reservoir

These impact topics cover the primary types of water quality impacts that could occur from surface water and groundwater changes caused by the Proposed Action and alternatives. Pollutant loads to Deer Creek Reservoir are a primary focus of the water quality analysis because they are an existing concern at the reservoir, and the Proposed Action and alternatives may affect upstream hydrology and runoff patterns.

3.3.2 Issues Eliminated From Further Analysis

None of the water quality issues identified during scoping and defined in Section 3.3.3 have been eliminated from further analysis.

3.3.3 Issues Addressed in the Impact Analysis

The following issues were defined during scoping and are assessed in the impact analysis:

- What baseline conditions would be used to analyze adverse or beneficial impacts on water quality under the WCWEP, and how would this baseline be established using past studies and existing data?
- What water quality impacts would occur from potential distribution of water in open waterways under the WCWEP and associated non-point sources of pollution?
- If conserved water is distributed into Heber Valley streams to provide instream flow, how would it affect water quality and nutrient loading to Deer Creek Reservoir?
- What water quality impacts would occur from conveyance of water through canals and ditches treated with herbicides?
- What water quality impacts would occur in upper Daniels Creek from eliminating the transbasin diversion?
- If conserved water were distributed into Heber Valley streams to provide instream flow, how would it affect the temperature of water discharged from Heber Valley streams to Deer Creek Reservoir?
- What impact would construction have on water quality, nutrient loading and sediment movement within existing waterways, streams and Deer Creek Reservoir? How would they be mitigated?

3.3.4 Description of Impact Area of Influence

The water quality impact area of influence consists of the surface water and groundwater resources that would be affected by the Proposed Action and alternatives, including the Provo River from Jordanelle Reservoir to Deer Creek Reservoir, certain streams and canals in Heber Valley, Daniels Creek, and Jordanelle and Deer Creek reservoirs. It also includes the lower Provo River between Deer Creek Reservoir and Utah Lake, and the upper Strawberry River basin tributary to Strawberry Reservoir (see Map 3-1 in Section 3.1.1).

3.3.5 Affected Environment (Baseline Conditions)

This section defines the water quality environment that would be affected by the Proposed Action and alternatives. The affected environment is the same as baseline conditions.

Previous studies indicate that Heber Valley has water quality problems, primarily elevated levels of phosphorus along the Provo River and in Deer Creek Reservoir (EWPE 1993b, 1994; Sowby and Berg 1984). Phosphorus levels in Deer Creek Reservoir in the past have exceeded the Jordanelle Technical Advisory Committee (JTAC) target recommendations for phosphorus, occasionally creating conditions that negatively affect recreational and aesthetic uses of the reservoir, as well as taste and odor problems in potable water supplies.

Deer Creek Reservoir is mesotrophic, meaning it has intermediate nutrient availability and biological productivity. Phosphorus is believed to be the limiting nutrient for algae productivity in the reservoir (Woodward-Clyde 1995), and concentrated efforts have been made to reduce phosphorus loading to control nuisance algae blooms (Loveless 1993). As a result of these efforts, nutrient water quality conditions in Heber Valley and Deer Creek Reservoir have been improving during the past 15 years and reservoir conditions now meet state water quality standards.

Construction of Jordanelle Reservoir is predicted to improve water quality in Heber Valley canals and streams and Deer Creek Reservoir, including reductions in sediment and phosphorus loads (Sowby and Berg 1984). The reservoir was constructed with a Selected Level Outlet Works (SLOW) to help protect downstream water quality by allowing water to be selectively discharged from different layers in the reservoir based on temperature. The water quality improvements predicted by Sowby and Berg (1984) were incorporated into the following baseline conditions. Sowby and Berg projected a reservoir TP concentration of 39 µg/l without sediment. They projected sedimentation at approximately 50 percent per year correcting the projected concentration of 39 µg/l for 50 percent sedimentation yields, an in-reservoir TP concentration of 20 µg/l. This value closely matches the 1993 monitored epilimnetic concentration of 21 µg/l TP (EWPE 1994).

3.3.5.1 Groundwater Quality

Baseline groundwater quality was estimated using existing groundwater quality data and projected changes in irrigation volumes and irrigation water quality. The estimated groundwater total phosphorus (TP) and nitrate (NO_3) concentrations for an average water year are 0.046 and 1.2 mg/L, respectively. The standard deviation (i.e., a measure of the variability of the data) for NO_3 concentrations is 0.8 mg/L, and the maximum monitored concentration is 3.2 mg/L (Hansen, Allen, and Luce 1994).

3.3.5.2 Surface Water — Canals and Streams

Baseline surface water quality in streams and canals was defined for herbicides, nutrients and sediment, and temperature.

3.3.5.2.1 Herbicides. The occasional use of herbicides by irrigation companies to control aquatic weed growth in some canals and ditches is expected to continue under baseline conditions. This practice is typically used on the entire reaches of the Sagebrush and Spring Creek Canal and the upper Charleston Canal and occasionally on River Ditch and Humbug and lower Charleston canals (Young 1995).

3.3.5.2.2 Nutrients and Sediment. Baseline concentrations of TP, total suspended solids (TSS) and NO_3 in valley streams and canals are presented in Table 3-20. The effects of existing nonpoint source pollution activities in Heber Valley are reflected in the existing monitoring data, and therefore are reflected in baseline conditions presented in Table 3-19. Nonpoint source pollution causing activities in the valley that influence water quality are primarily agricultural, but also include urban runoff. For example, the high nutrient and TSS concentrations found in lower Lake Creek reflect the nearby corrals, winter accumulation of pollutants that discharge to the creek during

Table 3-20
Average Year Baseline TSS, TP and NO3 Concentrations in Impact Area of Influence Streams
(Milligrams per Liter)

Location	TSS[a]	TP[b]	NO_3[c]
Jordanelle Reservoir Releases	0.8	0.021	0.034
Provo River Inflow to Deer Creek Reservoir	10.9	0.036	0.17
Spring Creek at the Provo River	39.6	0.091	0.31
Lower Daniels Creek	54.4	0.117	0.67
Daniels Creek at 1st Diversion	27.9	0.038	0.19
Rock Ditch at River Road	4.7	0.044	0.069
Lower Lake Creek	201	0.351	0.71

Notes:

[a] TSS = Total Suspended Solids
[b] TP = Total Phosphorus
[c] NO3 = Nitrate

snowmelt and early spring, and urban runoff from Heber City.

3.3.5.2.3 Temperature. The baseline mixing zone analysis conducted for this EIS concluded that in a worst-case, warm-water period during late summer of a dry year, cooler water discharged from the Jordanelle Reservoir to the Provo River reaches approximate background equilibrium temperature within 3,280 feet of the discharge point. The length of the mixing zone will vary during other times of the year, during different types of years or with cooler or warmer discharge waters from the reservoir.

3.3.5.3 Surface Water — Deer Creek Reservoir

Baseline surface water quality conditions for Deer Creek Reservoir were defined for sediment loads, eutrophication, and temperature and mixing status.

3.3.5.3.1 Sediment. Table 3-21 summarizes baseline TSS and TP loads to Deer Creek Reservoir from the Provo River, groundwater return flow and Daniels Creek during average hydrologic conditions. The sum of the loads from the three sources equals the total baseline load from the impact area of influence to Deer Creek Reservoir. The Provo River contributes a majority of the TSS and TP loads to the reservoir from the impact area of influence.

3.3.5.3.2 Eutrophication. Excess TP in reservoirs and other waters is a primary factor that can lead to eutrophication. The estimated average annual TP concentration in Deer Creek Reservoir using the phosphorus sedimentation model for average hydrologic and baseline conditions is 0.031 mg/L.

3.3.5.3.3 Temperature and Mixing Status. Under existing conditions Deer Creek Reservoir is dimictic (i.e., the reservoir mixes vertically once in the spring and once in fall). Vertical mixing during mid- to late summer is prevented by thermal stratification. Stratification begins in June, is pronounced through July and August, then lessens in September. The entire water column starts to reach similar temperatures before turnover in late September or early October (Woodward-Clyde 1995, EWPE 1994).

Table 3-21
Baseline TSS and TP Loads to Deer Creek Reservoir
(Kilograms per Year)

Water Year Type and Parameter	Provo River	Groundwater Return Flow[1]	Daniels Creek	Total
Average				
TSS[2]	3,560,950	0	563,450	4,124,400
TP[3]	11,860	1,360	1,210	14,430
Dry				
TSS	2,405,780	0	393,180	2,798,960
TP	8,435	1,535	850	10,820
Wet				
TSS	4,766,900	0	1,342,170	6,109,070
TP	15,850	1,180	2,890	19,920

Notes:
[1] Groundwater for load analysis based on predicted concentrations.
[2] TSS = Total Suspended Solids
[3] TP = Total Phosphorus

The PROSIM model, described in Section 3.2 and Appendix B.2.1, modeled average Deer Creek Reservoir surface elevation for baseline conditions at 5,397 feet. The minimum elevations modeled for July and August over the 30-year record modeled, are 5,338 and 5,330 feet, respectively. The baseline average depth is 117 feet, and minimum depths are 58 feet for July and 50 feet for August. All of these elevations are sufficient to maintain maximum water depths greater than the 33 feet found by Heiskary and Wilson (1990) as the depth necessary to maintain temperature stratification.

3.3.6 Impact Analysis

3.3.6.1 Significance Criteria

The following criteria were used to assess the significance of impacts on water quality:

- Groundwater nitrate concentrations were assessed based on the State of Utah Water Quality Standard for Domestic Waters of 10 mg/L.
- Nitrate concentrations in streams and canals were assessed based on the State of Utah Water Quality Standard for Aesthetics and Aquatic Wildlife of 4 mg/L.
- Eutrophication of Deer Creek Reservoir was assessed as a 0.002 mg/L increase in the predicted reservoir TP concentration.
- The reservoir temperature and mixing status was assessed based on maintaining a minimum reservoir depth necessary to maintain strong thermal stratification during critical late-summer periods — about 33 feet based on work by Heiskary and Wilson (1990).

Since there are no state standards for TP and TSS concentrations and loads, significance criteria for these parameters were not developed. Water quality significance criteria were also not developed for herbicides, TP concentrations in groundwater, and stream temperatures. Groundwater concentrations of TP were estimated as part of the total TP entering Deer Creek Reservoir. Significance of impacts for herbicides and stream temperature are determined in the Aquatic Resources analysis in Section 3.5.

3.3.6.2 Potential Impacts Eliminated From Further Analysis

The following issue was eliminated from further analysis:

- What impact would construction have on water quality, nutrient loading and sediment movement within existing waterways, streams and Deer Creek Reservoir? How would construction impacts on water quality be mitigated?

This issue was eliminated because the soil analysis in Section 3.8 (Soil Resources) concluded that construction of the Proposed Action and alternatives would cause negligible amounts of soil to enter adjacent streams and canals.

3.3.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following subsections define potential water quality impacts from the Proposed Action during construction and operation.

3.3.6.3.1 Groundwater Quality. Throughout the valley, NO_3 concentrations for the Proposed Action do not change from baseline conditions defined in Section 3.3.5.1. Predicted baseline and Proposed Action groundwater NO_3 concentrations are the same at 1.2 mg/l. The exception is an increase of 0.1 mg/L (9%) during wet-year hydrologic conditions caused by decreased dilution of groundwater from irrigation compared to baseline. However, the increase would not cause NO_3 concentrations to exceed the significance criteria. Localized concentrations, based on a maximum monitored single-sample concentration of 3.2 mg/L, would not increase to levels approaching or exceeding the significance criteria. Therefore, the increase in NO_3 groundwater concentrations under the Proposed Action would not be significant.

3.3.6.3.2 Surface Water — Streams and Canals. Surface water quality impacts in streams and canals from the Proposed Action were evaluated for herbicides, nutrients and sediment, and temperature.

3.3.6.3.2.1 Herbicides. The Proposed Action would improve water quality in the two canals that would be used to convey water by the Proposed Action and currently receive herbicide applications under baseline conditions. These are the Humbug Canal and the Sagebrush and Spring Creek Canal. The Proposed Action would achieve a uniform grade of the Humbug Canal eliminating slow flowing areas where aquatic weeds grow compared to baseline conditions. Therefore, the need to apply herbicides in the canal would likely be reduced since fewer weeds would grow.

The Proposed Action would reduce herbicide applications in areas where open canals would be replaced with buried pipelines. In other canals and streams, the Proposed Action would not change herbicide concentrations because herbicide applications would not change (see results of the Agriculture analysis in Section 3.11).

3.3.6.3.2.2 Nutrients and Sediments. Predicted concentrations of TSS, TP and NO_3 in streams within the impact area of influence under the Proposed Action are presented in Table 3-22. TSS and TP concentrations would either decrease or stay the same as baseline conditions in all streams and canals evaluated. Reductions of TSS and TP concentrations in Spring Creek, Rock Ditch and lower Lake Creek would primarily result from the addition of supplemental water from Jordanelle Reservoir that would have very low concentrations of TSS and TP.

TSS and TP concentrations in London Ditch would likely decrease under the Proposed Action during all types of water years. London Ditch would receive supplemental flow from Jordanelle Reservoir, which would dilute pollutants.

Supplemental flows would dilute some pollutants in Creamery Ditch, but would increase the potential for migration of TSS and TP to and from Creamery Ditch from two one-quarter-acre corrals located along the ditch. While this migration might be balanced by the dilution, there is potential for slight increases in TP and TSS. But the increase is considered not significant because the corrals are so small are already located on the ditch and are contributing nutrients and sediment to the ditch under baseline conditions.

Sediment and nutrient concentrations in lower Daniels Creek would likely decrease because of the elimination of the flow in and discharge from the Lower Charleston Canal. Historical monitoring data

Table 3-22
Proposed Action TSS, TP and NO_3 Concentrations* and Impacts for Impact Area of Influence Streams — Wet Water Year
(Milligrams per Liter)

Description	Provo River Inflow to Deer Creek Reservoir	Spring Creek	Rock Ditch	Lower Lake Creek
Total Suspended Solids (TSS)				
Baseline	10.9	39.6	4.7	201
Proposed Action	10.4	26.4	4.1	20.6
Difference	-0.5	-13.2	-0.06	-180.4
% Change	-4.6	-33	-13	-90
Total Phosphorus (TP)				
Baseline	0.036	0.091	0.044	0.35
Proposed Action	0.034	0.076	0.037	0.070
Difference	-0.002	-0.015	-0.007	-0.28
% Change	-6	-16	-16	-80
Nitrate (NO_3)				
Baseline	0.17	0.31	0.069	0.71
Proposed Action	0.16	0.21	0.063	0.13
Difference	-0.01	-0.10	-0.006	-0.58
% Change	-6	-32	-9	-82

Note:
*Concentrations used for water released from Jordanelle Reservoir were 0.8 mg/L TSS, 0.021 mg/L TP, and 0.034 mg/L NO_3 for baseline conditions and the Proposed Action.

(EWPE 1993b and 1994) has shown the canal is a significant source of sediment and nutrients to lower Daniels Creek and Deer Creek Reservoir.

Concentrations in upper Daniels Creek would not likely change because land-use activities in the upper Daniels Creek basin would not be altered by the Proposed Action. In addition, land-use activities in the upper Strawberry River basin are generally similar to the upper Daniels Creek basin. Therefore, elimination of the water diverted from the upper Strawberry River basin should not change the quality in Daniels Creek.

Results of the water resources analysis (see Section 3.2) for the Provo River at the Provo City gage showed that annual average flows under the Proposed Action would not change for average and dry years, and decrease slightly (i.e., 1 percent) for wet years. This minor change would not affect nutrient and sediment concentrations in this reach of the river. The Proposed Action also would not affect nutrient and sediment concentrations in the Provo River below Deer Creek Reservoir. The Proposed Action would not impact water quality in Deer Creek Reservoir (see Section 3.3.6.3.3), so subsequent discharges to the lower reaches of the Provo River would not have water quality impacts.

Abandonment and removal of the DIC diversion system in the upper Strawberry River basin by the USFS could cause a slight increase in localized erosion and sedimentation. However, other aspects of the abandonment and removal plan would decrease erosion currently occurring at headcuts and other problem areas. The net result would be decreased erosion and sedimentation and improved water quality.

3.3.6.3.2.3 Temperature. Modeled water releases from Jordanelle Reservoir under the Proposed Action during August of dry years (i.e., a worst-case temperature condition) are approximately 7 percent higher than baseline conditions (see Section 3.2, Water Resources) . This change in flow would not change the length of the transition zone below the reservoir compared to baseline conditions. Therefore, changes in discharge rates from Jordanelle Reservoir under the Proposed Action would not affect temperatures in Rock Ditch, Creamery Ditch, London Ditch, lower Lake Creek and Spring Creek under worst-case temperature conditions.

Elimination of the diversion from the upper Strawberry River basin to upper Daniels Creek would decrease the flow in Daniels Creek. However, the water diverted from the upper Strawberry River basin generally comes from gentle south-facing slopes where the potential for solar heating is greater than in Daniels Canyon. Also, the Proposed Action would not change the shading characteristics of the riparian corridor along Daniels Creek. Therefore, elimination of relatively warmer water from the Strawberry River basin diversions would not change or would only slightly decrease the temperature of Daniels Creek as temperature conditions in the creek become more representative of ambient meteorological conditions and natural groundwater return flows.

3.3.6.3.3 Surface Water — Deer Creek Reservoir. Surface water quality impacts on Deer Creek Reservoir from the Proposed Action were evaluated for sediment, eutrophication, and temperature and mixing status.

3.3.6.3.3.1 Sediment. Table 3-23 summarizes the estimated annual TSS loads from Heber Valley to Deer Creek Reservoir under the Proposed Action for an average water year. The annual TSS loads to the reservoir would decrease under the Proposed Action compared to baseline conditions, except for dry years when TSS loads increase by 2 percent (65,740 kg/yr). Decreased loads to the reservoir are primarily due to decreased loads from lower Daniels Creek to the reservoir. These reductions are caused by the elimination of irrigation diversions in lower Charleston Canal and flow reductions in Sagebrush Spring Creek Canal.

3.3.6.3.3.2 Eutrophication. The annual average TP concentrations in the reservoir would decrease or remain the same compared to baseline conditions as defined in Section 3.3.5.3.2. This finding is supported in the results of a sensitivity analysis conducted by Woodward-Clyde (1995). Using a water quality model of the reservoir, this analysis found that sensitivity of water quality changes in the reservoir would be minimal from changes in external phosphorus loads, with the change in TP load within a 10 percent range of average. Therefore, the Proposed Action would not increase annual average TP concentrations in Deer Creek Reservoir, and the TP impacts of the Proposed Action would not be significant.

3.3.6.3.3.3 Temperature and Mixing Status. Average and late-summer minimum elevations of Deer Creek Reservoir surface water under the Proposed Action would be sufficient to maintain reservoir depths conducive to thermal stratification. The depths would be 45 feet or more, which is greater than the significance criterion of 33 feet or less. Therefore, the Proposed Action would not affect thermal stratification, and the related impacts would not be significant.

3.3.6.3.4 Impact Summary. Water quality impacts under the Proposed Action are generally positive and not significant.

3.3.6.4 Daniel Replacement Project With Pipeline Alternative

The following subsections define potential water quality impacts from the DRP With Pipeline Alternative.

3.3.6.4.1 Groundwater Quality. Throughout the valley, NO_3 concentrations for the DRP With Pipeline Alternative decrease slightly, 0.1 to 0.2 mg/L, from baseline conditions because of the decreased mass of NO_3 from the upper Strawberry River basin diversions. Slight decreases in NO_3

Table 3-23
Proposed Action TSS Loads and Impacts to Deer Creek Reservoir for an Average Water Year (kilograms per year)

Description	Source			
	Provo River	**Groundwater**	**Lower Daniels Creek**	**Total**
Total Suspended Solids (TSS)				
Baseline	3,560,950	0	563,450	4,124,400
Proposed Action	3,954,910	0	145,990	4,100,900
Difference	393,960	0	-417,460	-23,500
% Change	11	0	-74	-0.6

groundwater concentrations would have a positive impact.

3.3.6.4.2 Surface Water Streams and Canals. Surface water quality impacts in streams and canals were evaluated for herbicides, nutrients and sediment, and temperature.

3.3.6.4.2.1 Herbicides. The DRP With Pipeline Alternative would not affect herbicide-related water quality in the impact area of influence because it would not affect any canals where herbicides are used by irrigation companies to control weed growth. The Agriculture analysis in Section 3.11 also concludes that this alternative would not change herbicide applications. Therefore, this alternative would not cause a change from baseline conditions, and herbicide-related water quality impacts would not occur.

3.3.6.4.2.2 Nutrients and Sediments. Table 3-24 summarizes the estimated concentrations of TSS, TP and NO_3 in the Provo River inflow to Deer Creek Reservoir under the DRP With Pipeline Alternative. TSS and TP (and NO_3) concentrations in the Provo River would decrease compared to baseline, which would have a positive impact.

No change is expected in Spring Creek, Rock Ditch, lower Lake Creek, Creamery Ditch and London Ditch since these would not receive supplemental instream flows under this alternative.

Concentrations of nutrients and sediment in lower Daniels Creek would not change. The water quality in lower Daniels Creek is controlled by snowmelt and return flow discharges from the Sagebrush and Spring Creek Canal and the Lower Charleston Canal. These flows and discharges would not be changed by the DRP With Pipeline Alternative.

Impacts related to concentrations in upper Daniels Creek and streams in the upper Strawberry River basin would be the same as those for the Proposed Action described in Section 3.3.6.3.2.2. These impacts would not be significant.

3.3.6.4.2.3 Temperature. Temperature impacts in the Provo River and upper Daniels Creek under the DRP With Pipeline Alternative would be the same as those presented for the Proposed Action. These impacts would not be significant.

3.3.6.4.3 Surface Water — Deer Creek Reservoir. Surface water quality impacts on Deer Creek Reservoir from the alternative were evaluated for sediment, eutrophication, and temperature and mixing status.

3.3.6.4.3.1 Sediment. Table 3-25 summarizes the estimated annual TSS loads from the impact area of influence to Deer Creek Reservoir under the DRP With Pipeline Alternative. The annual TSS load contributed to the reservoir would increase slightly under this alternative.

Table 3-24
DRP With Pipeline TSS, TP and NO3 Concentrations* and Impacts for Provo River Inflow to Deer Creek Reservoir in an Average Water Year (Milligrams per Liter)

Description	Provo River Inflow to Deer Creek Reservoir
Total Suspended Solids (TSS)	
Baseline	10.9
Proposed Action	9.7
Difference	-1.2
% Change	-11
Total Phosphorus (TP)	
Baseline	0.036
Proposed Action	0.032
Difference	-0.004
% Change	-11
Nitrate (NO3)	
Baseline	0.17
Proposed Action	0.15
Difference	-0.02
% Change	-12

Note:

*Concentrations used for water released from Jordanelle Reservoir were 0.8 mg/L TSS, 0.021 mg/L TP, and 0.034 mg/L NO3 for baseline conditions and the Proposed Action.

Table 3-25
DRP With Pipeline Alternative TSS Loads and Impacts to Deer Creek Reservoir in an Average Water Year (Kilograms per Year)

Description	Source			
	Provo River	Groundwater	Lower Daniels Creek	Total
Total Suspended Solids (TSS)				
Baseline	3,560,950	0	563,450	4,124,400
Proposed Action	3,533,400	0	595,440	4,128,840
Difference	-27,550	0	31,990	4,440
% Change	-1	0	6	0.1

3.3.6.4.3.2 ***Eutrophication.*** The annual average TP concentrations in the reservoir would decrease or remain the same compared to baseline conditions defined in Section 3.3.5.3.2 (Woodward-Clyde 1995). Using a water quality model of the reservoir, Woodward-Clyde found that sensitivity of water quality changes in the reservoir from changes in external phosphorus loads would be minimal, with the change in TP load within a range of 10 percent of average. Therefore, the DRP With Pipeline Alternative would not increase annual average TP concentrations in Deer Creek Reservoir, and the TP impacts of the alternative would not be significant.

3.3.6.4.3.3 ***Temperature and Mixing Status.*** Both average and minimum elevations, as presented in Section 3.2, Water Resources, and modeled in the reservoir under the DRP With Pipeline Alternative, would be sufficient to maintain reservoir depths conducive to thermal stratification. Reservoir water depths would be 45 feet or more, which is greater than the significance criterion of 33 feet or less depth. Therefore, the DRP With Pipeline Alternative would not affect thermal stratification, and the related impacts would not be adverse or significant.

3.3.6.4.4 Impact Summary. Water quality impacts under the DRP With Pipeline Alternative are generally positive and are not significant.

3.3.6.5 Daniel Replacement Project With Canal

The following subsections define potential water quality impacts from the DRP With Canal Alternative.

3.3.6.5.1 Groundwater Quality. Estimated groundwater concentrations of NO_3 throughout the valley under this alternative would be the same as those presented under the DRP With Pipeline Alternative. These slight decreases in NO_3 groundwater concentrations under the DRP With Canal Alternative would have a positive impact.

3.3.6.5.2 Surface Water — Streams and Canals. Surface water quality impacts in streams and canals were evaluated for herbicides, nutrients and sediment, and temperature. Water quality impacts for herbicides and nutrients and sediment would be the same as those under the DRP With Pipeline Alternative in subsections 3.3.6.4.2.1 and 3.3.6.4.2.2.

3.3.6.5.2.1 ***Herbicides.*** The DRP With Canal Alternative would not affect herbicide-related water quality in the impact area of influence because it would not affect any canals where herbicides are used by irrigation companies to control weed growth. The Agriculture analysis presented in Section 3.11 also concluded the DRP With Canal Alternative would not change herbicide applications. This alternative would not cause a change from baseline conditions and, therefore, herbicide-related water quality impacts would not occur under this alternative.

3.3.6.5.2.2 ***Temperature.*** Temperature impacts in the Provo River and upper Daniels Creek under this alternative would be the same as those presented for the Proposed Action. These impacts would not be significant.

3.3.6.5.3 Surface Water — Deer Creek Reservoir. Surface water quality impacts on Deer Creek Reservoir under this alternative were evaluated for sediment, eutrophication, and temperature and mixing status. Water quality impacts for sediment and eutrophication are the same as those for the DRP With Pipeline Alternative. These impacts are generally positive, and adverse impacts are not significant. Impacts of temperature and mixing status are slightly different from the DRP With Pipeline Alternative and are discussed below.

3.3.6.5.3.1 ***Temperature and Mixing Status.*** Modeled elevations in the reservoir under the DRP With Canal Alternative, both average and minimum, would be sufficient to maintain reservoir depths conducive to thermal stratification. The reservoir water depths would be 41 feet or more, which is greater than the significance criterion of 33 feet or less. Therefore, the DRP With Canal Alternative would not affect thermal stratification, and the related impacts would not be significant.

3.3.6.5.4 Impact Summary. The water quality impacts of the DRP With Canal Alternative would be the same as those presented for the DRP With Pipeline Alternative. These impacts are generally positive and are not significant.

3.3.6.6 No Action Alternative

The No Action Alternative would result in no impacts on water quality because neither the WCWEP nor the DRP would be implemented. The baseline water quality conditions would continue, and the water quality impacts described in this section would not occur.

3.4 Wetlands Resources

3.4.1 Introduction

The wetlands analysis addresses potential impacts on wetlands from the construction, operation and maintenance of the Proposed Action and alternatives. The information and analysis documented in this section was summarized from the Draft Wetlands Technical Report (CUWCD 1996d), which is available from CUWCD upon request. The assumptions and impact topic analysis methods are summarized in Appendix B, Section B.2.3.

An individual 404 Permit would not be required for the Proposed Action and alternatives. The U.S. Army Corps of Engineers (COE) would not have jurisdiction over construction of the pipelines because their purpose is to carry irrigation water (33 CFR Part 324 (a)(3)). Reconstruction of the Timpanogos diversion structure would not be regulated by the COE because it is considered appurtenant and functionally related to irrigation ditches, it is being constructed in essentially the same location and does not draw more water from the river than previously ([33 CFR Part 324 (a)(3)] commonly referred to as the "recapture clause"). A Nationwide Permit may be required for some of the work in the upper Strawberry River basin.

The analysis in this section of Chapter 3 focuses on all potential wetland types that could be impacted, including direct, indirect, short-term and long-term impacts to wet and moist meadows, emergent marshes, shrub wetlands and riparian woodland. The following wetland impact topics are addressed in the impact analysis:

- Impacts on wetlands from construction of WCWEP and DRP facilities, including pipelines, Timpanogos diversion, a new operation and maintenance road and pumping stations
- Impacts on wetlands from operating the WCWEP and DRP, including changes in irrigation practices, enhanced stream flows in Heber Valley streams and reduced stream flows in Daniels Creek
- Impacts on wetlands from a reduction of seepage from canals that are dewatered by the WCWEP and DRP

3.4.2 Issues Eliminated From Further Analysis

None of the wetland issues raised during scoping and defined in Section 3.4.3 have been eliminated from further analysis.

3.4.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- How would enlargement of the Timpanogos Canal affect seepage that currently provides water to wetlands?
- What effects would conversion from flood to sprinkler irrigation under the WCWEP have on wetlands in Heber Valley?
- What effects would the proposed Daniel Replacement pipeline alignment have on wetlands?
- How would wetland impacts from the Daniel Replacement pipeline be mitigated?
- What effects would conversion from flood to sprinkler irrigation under the WCWEP have on wetlands in Heber Valley?
- Would the upper Daniels Creek riparian wetlands be sustainable without trans-basin water from the Strawberry River basin?
- What effects would the WCWEP water distribution system have on existing wetlands?
- What would be the source of water for restoration of wetlands if they are affected by the WCWEP?

- What impacts would reduced canal seepage caused by the WCWEP have on wetlands, and would irrigation be required to rehydrate impacted wet areas?

3.4.4 Description of Impact Area of Influence

The impact area of influence consists of wetland habitats, in Heber Valley, supported by flows in Daniels Creek, in the upper Strawberry River basin, and immediately adjacent to the Provo River below Deer Creek Reservoir extending to Utah Lake. The analysis addresses potential impacts on these areas from construction of project features; groundwater drawdown from converting flood to sprinkler irrigation; and flow changes in canals, Daniels Creek, Strawberry River and tributaries, and the Provo River below Deer Creek Reservoir.

3.4.5 Affected Environment (Baseline Conditions)

Wetland types in the Heber Valley impact area of influence include wet and moist meadows, emergent marshes, shrub wetlands and riparian woodland. Table 3-26 presents the five wetland types, their mapping symbol used on Map A-3, and the acreage of each type in the Heber Valley impact area of influence.

The USFS conducted a preliminary inventory of the upper Strawberry River basin wetlands to identify areas that would be impacted and enhanced. Wetland types in the upper Strawberry River basin include wet meadow, emergent marsh, shrub wetlands and riparian woodland. Map 3-6 shows the locations of these wetlands.

Wetland mapping was not prepared for Daniels Creek and the Provo River below Deer Creek Reservoir, however these areas are dominated by shrubs and riparian woodland. The subsections following Table 3-26 describe how each wetland type would be potentially impacted by the Proposed Action and alternatives.

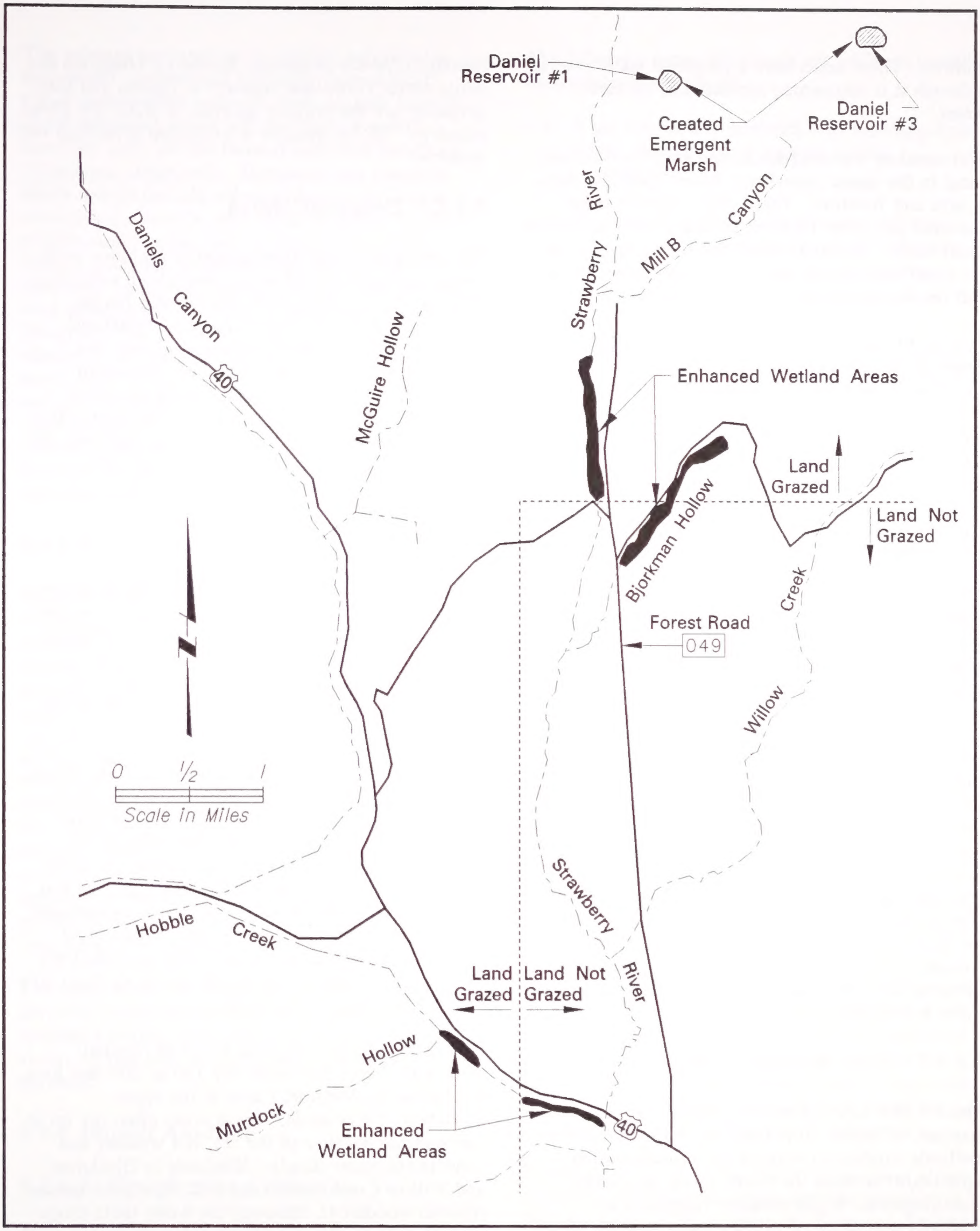
3.4.5.1 Wet Meadow Complex

The wet meadow complex totals 1,613 mapped acres, of which 80 percent is wetland. This mapping unit encompasses the most wetland area — about 1,290 acres, or 20 percent of the total wetland area in the impact area of influence. Wet meadows are most prevalent in the southern and eastern portions of the North Fields region, and are more scattered in the remainder of North Fields and in the South Fields region. Large, wet meadows are located on the east and north sides of Deer Creek Reservoir.

Wet meadow complexes are associated with the Bjorkman/Willow Creek canal. These short, narrow strips, scattered along the edges of the canal, depend on diverted irrigation water. Wetlands associated with the lower part of the Bjorkman headcut are more continuous, extend up to 3 feet wide, and also depend on diverted water. Existing wetlands between the Bjorkman headcut and the diversion in Bjorkman Creek are up to 30 feet wide and include

Table 3-26
Summary of Wetland Types and Area in Heber Valley Impact Area of Influence

Wetland Type	Mapping Symbol on Map A-3 in Map Pocket	Wetland Area In Impact Area of Influence (acres)
Wet Meadow Complex	A	1,290
Moist Meadow Complex	B	308
Emergent Marsh	EM	44
Riparian Woodland	WR	199
Shrub Wetland	SW	25
Total Acreage		**1,866**



Map 3–6
Wetlands Enhanced and Created in
Upper Strawberry River Basin

willows. These areas have a perennial water source, although it is augmented substantially by canal water.

Wet meadow wetlands associated with the McGuire canal in the upper Strawberry River basin also vary in size and function. These short, narrow strips scattered along the edges of the canal also depend on canal water. Wetlands below the McGuire headcut are small and vary in size, but are natural wetlands that receive additional water from the canal.

Two small wet meadow wetlands are found in the Point of the Pines Canal in the upper Strawberry River basin between Murdock diversion and the head of Daniels Creek canyon. The USFS estimates that these wetland areas extend the width of the canal for 200 to 300 feet. Wetlands below the diversion are at a low functional level because water is being diverted, but the wetlands persist because the diversions are either not used or are only used briefly during high runoff.

Wetlands associated with the two Daniel reservoirs in the upper Strawberry River basin consist of a band of wet meadow one-half to 3 feet wide along the high-water level. These wet meadow wetlands dry up by mid-summer when the water level is lowered.

The USFS characterized the wet meadow vegetation in the upper Strawberry River basin as consisting of mostly grasses and grass-like plants averaging 1 to 2.5 feet high. The common plant species include: spreading bentgrass *(Agrostis stolonifera),* water sedge *(Carex aquatilis),* Nebraska sedge *(Carex nebrascensis)*, blackcreeper sedge *(Carex praegracilis)*, spikerush *(Eleocharis* spp.), wiregrass *(Juncus arcticus)*, Nevada rush *(Juncus nevadensis)* and Kentucky bluegrass *(Poapratensis).* The primary source of wetland hydrology is flood and sub-irrigation from upgradient irrigation and natural water movement.

3.4.5.2 Moist Meadow Complex

About 3,084 acres of moist meadow complex were mapped, of which 10 percent, or 308, acres are wetlands existing in most of the flood-irrigated agricultural lands in the North Fields and South Fields regions. Moist meadow vegetation is primarily composed of grasses and grass-like plants averaging 1 to 4 feet high. The common species include: spreading bentgrass, water sedge, rush, timothy *(Phleum pratense)*, Kentucky bluegrass and white clover *(Trifolium repens).* Irrigation and sub-irrigation are the primary sources of water for moist meadows. Moist meadow is somewhat drier than wet meadow.

3.4.5.3 Emergent Marsh

The emergent marsh type primarily includes erect, rooted herbaceous vegetation, along with adjoining rings of wet meadow where the marshes border uplands. It includes areas dominated by cat-tail *(Typha latifolia),* bulrush *(Scirpus validus)* and water-cress *(Nasturtium officinale)*. Emergent marsh occurs in scattered, small areas generally adjacent to and downstream of the Utah State Fish Hatchery and in roadside ditches along Highway 40 north of Heber City. These marshes are 100 percent wetland and cover about 44 acres.

3.4.5.4 Riparian Woodland

Riparian woodland, which are dominated by native and introduced tree species, are found along smaller streams and along ditches and canals. As mapped, the riparian woodland mapping unit contains 25 percent wetlands. Following is a description of riparian woodlands found throughout much of the valley.

Riparian woodlands along Spring Ditch, Lake Creek, Daniels Creek and portions of Snake Creek appear natural, but most are dominated by crack willow *(Salix fragilis)*, a species introduced after Heber Valley was settled during the mid 1800s. A narrow band of riparian woodland with a more diverse mix of vegetation, is found along the banks immediately adjacent to the lower Provo River. While most riparian woodland areas in the valley are relatively healthy, those along Lake Creek are dying from lack of water because of diversions.

Canal seepage sustains small bands of riparian woodland, 1 to 3 feet wide and 100 to 200 feet long, just below the McGuire Canal in the upper Strawberry River basin. These areas often dry up in late summer because of the dry, hot weather and insufficient water supply. Wetlands in Bjorkman and Willow Creeks below the DIC diversions sustain riparian woodlands, although the water table drops more than it would naturally because of the diversions.

The primary tree species in riparian woodland is narrowleaf cottonwood (*Populus angustifolia*). Other dominant or common trees include boxelder *(Acer negundo),* crack willow *(Salix fragilis),* speckled alder *(Alnus incana)* and river hawthorn *(Crataegus douglasii).* Dominant and common shrub species include red-oiser dogwood *(Cornus stolonifera),* Wood's rose *(Rosa woodsii),* coyote willow *(Salix exigua)* and yellow willow *(Salix lutea).* Common understory species include spreading bentgrass, horsetail *(Equisetum arvense),* reed canarygrass *(Phalaris arundinacea),* fowl bluegrass *(Poa palustris),* European bittersweet *(Solanum dulcamara)* and golden pea *(Thermopsis montana).* Common upland understory vegetation includes Canada thistle *(Cirsium arvense),* ryegrasss *(Elymus spp.),* brome *(Bromus spp.),* orchard-grass *(Dactylis glomerata),* bryony *(Bryonia alba),* timothy, Kentucky bluegrass and false Solomon's seal *(Smilacina spp.).*

3.4.5.5 Shrub Wetland

Shrub wetlands, dominated by tall shrubs (principally willows), are located in a number of different habitats, including scattered locations adjacent to springs, and along ditches and creeks in wetter, abandoned agricultural lands. These wetlands occur primarily in areas too wet for most land uses, except recreation or wildlife habitat, and comprise about 25 acres in the Heber Valley portion of the impact area of influence. As mapped, the shrub wetland mapping unit contains 100 percent wetlands. Dominant shrub species include coyote willow *(Salix exigua),* yellow willow *(Salix lutea)* and river hawthorn *(Crataegus douglasii).* Dominant herbaceous species are reed canarygrass *(Phalaris arundinacea),* fowl bluegrass *(Poa palustris)* and duckweed *(Lemna sp.).*

The wetland on the Strawberry River from the diversion downstream to the first road crossing sustains a healthy stand of willows, but looses its ability to function naturally when the water is diverted.

3.4.6 Impact Analysis

3.4.6.1 Significance Criteria

The wetland significance criteria are based on federal regulations and standards and professional judgment. The following types of impacts on wetlands would be considered significant:

- A net loss of any wetlands area resulting from filling, excavating or draining during construction
- Wetlands functions and values are reduced because of changes in water supply affecting plant communities, groundwater recharge, groundwater discharge, sediment stabilization and wildlife habitat

3.4.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential wetland impacts have been eliminated from further analysis.

3.4.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following subsections describe potential wetland impacts from the construction and operation of the Proposed Action. Table 3-27 summarizes wetland impacts. All wetland impacts have been calculated to include only the percentages of the mapping units that are wetland.

About 22.8 acres of wetlands would be disturbed or permanently removed under the Proposed Action. In Heber Valley, 20.7 acres of wet meadow wetlands would be indirectly converted to upland from groundwater drawdown (see Map A-4 in pocket at back of EIS). About 2.1 acres would be converted to upland from removal of the existing water supply from canals associated with DIC irrigation facilities in the upper Strawberry River basin. About 70.4 acres that were previously wetlands, but have been invaded by upland species, would be enhanced in the upper Strawberry River basin from returning flows to streams that are presently diverted. An additional 6 acres would be created in upper Strawberry River basin, including 3.4 acres around the DIC reservoirs and 2.6 acres adjacent to streams that would no longer be diverted dry in the summer months.

Wetlands along the Provo River below Deer Creek Reservoir would not be measurably impacted by changes in river flows under the Proposed Action. These changes would be within the normal range of seasonal fluctuations under baseline conditions. The

Table 3-27
Summary of Adverse and Beneficial Wetland Impacts Under the Proposed Action (WCWEP With Daniel Replacement Pipeline)

Impact Type	Wet Meadow (acres)	Emergent Marsh (acres)	Riparian Woodland (acres)	Shrub Wetland (acres)	Total (acres)
Indirect adverse impacts — Heber Valley and upper Strawberry River basin	20.7	0	2.1	0	-22.8
Created wetlands in upper Strawberry River basin	0	3.4	0	2.6	6.0
Enhanced wetland quality and functions — upper Strawberry River basin	36.8	0	0	33.6	+70.4
Net change in wetland acres — Heber Valley and upper Strawberry River basin	+16.1	+3.4	-2.1	+36.2	+53.6

maximum decrease in flow at the Provo City gage would be 378 cfs (28 percent), which would result in a flow of 964 cfs during hydrologic conditions modeled for June 1968. The June 1968 hydrologic conditions at the Provo City gage would be followed by flows of 11 cfs during July 1968 hydrologic conditions, which would be a 10 cfs increase compared to baseline conditions. Modeled hydrologic conditions during August and September 1968 indicate flows at the Provo City gage would be 1 cfs under the Proposed Action and baseline conditions. The flow changes would result in unmeasurable fluctuations in river water levels compared to baseline conditions resulting in negligible impacts on riparian woodlands and shrub wetlands along the river and on emergent marshes in backwater areas upstream of diversions.

3.4.6.3.1 Wet Meadow. A total of 22.6 acres of wet meadow would be impacted by the Proposed Action.

Analysis of results of the MODFLOW hydrology model (see Section 3.2, Water Resources) indicate that there would be a 2 foot or greater groundwater elevation drawdown on the east side of the Provo River. Wetlands that could be affected by this drawdown were identified on the wetland inventory map and investigated in the field on April 2, 1996. The field investigation, conducted after snowmelt runoff and prior to the irrigation season, revealed that most of the wetlands that were in the groundwater drawdown influence area are supported by other water sources such as springs and drainage ditches. However, about 20.7 acres of wet meadow wetland could be converted to upland by lowering groundwater elevations associated with converting from flood to sprinkler irrigation. As groundwater levels recede because of changes in irrigation practices, wet meadow vegetation may be gradually replaced over an estimated 3 to 5 years by upland species that are adapted to less water. Wetland specialists investigated the 20.7 acres of wet meadow wetlands and determined these areas provide limited wetland functional value. This private property is used for livestock grazing and hay production. Flood irrigation and upgradient drainage supports wetland vegetation. Vegetation is limited to a monoculture of herbaceous species, and soils are sands and gravels. There is very little habitat provided for wildlife. Map A-4 (in pocket at back of EIS) shows the extent of these impacts and explains why other wetlands would not likely be impacted by the groundwater drawdown. Based on preliminary information received from the COE, the potential wetland impacts from groundwater elevation drawdown would not be regulated under Section 404 of the Clean Water Act because the drawdown is related to irrigation practices for which a 404 Permit is not required.

Wet meadows in the North Fields area would not be impacted by the Proposed Action because groundwater elevations would not change from baseline levels.

There would be limited benefits to wetland and riparian vegetation from increased flows in Heber Valley streams because livestock-grazing practices would not be changed under the Proposed Action. Any increase in vegetation from increased flows would be grazed, reducing potential benefits to riparian and aquatic habitats.

No wetland impacts would occur from the reconstruction of the Timpanogos Diversion. Some cottonwood trees would require trimming and several shrubs would be cleared

Construction of pump stations and irrigation laterals would have no measurable impacts on wet meadow wetlands because the pipelines would be located to avoid wetland impacts. Any unavoidable wetland impacts would be minor, short-term, direct impacts from excavation for pipe trenches and removal of small amounts of shrubs and herbaceous vegetation. These pipelines would be constructed mostly through agricultural fields and pastures. Any disturbed areas would be restored in 2 to 3 full growing seasons. These activities would not significantly affect wetland functions and values associated with any larger wetland areas where impacts could occur.

The USFS estimates that restoring natural stream flows in the upper Strawberry River basin would enhance functions on 36.8 acres of existing wet meadow wetlands. These areas were once dominated by sedges, but silver sage invaded when water was diverted from Willow Creek. The USFS believes that returning flows to Willow Creek would promote wetter conditions and support the former wet meadow communities which existed in these areas before the water was diverted. The new flows would be similar to hydrology that previously supported wetlands in these areas. The restoration would occur over several years as the soil profile gradually becomes wetter from increased flows.

Approximately 24 acres of the 70.4 acres of wetlands that would be enhanced is in an area that is presently not grazed. This area is managed by guidance from the USFS Strawberry Valley EIS and its Record of Decision. The direction from these documents is to manage for watershed and wildlife values, with livestock being removed until specific objectives are met, including those objectives for riparian and wetland enhancement. The remaining 46.4 acres of the total 70.4 acres are within areas presently being grazed. These areas are managed in accordance with the standards and guidelines outlined in the Uinta National Forest Rangeland Ecosystem Forest Plan Amendment which establishes utilization, bank stabilization and ground cover standards that are vegetative-community specific. The riparian and wetland standards are broken into three categories, with the most strict being applied to the areas associated with this project. Under these standards, off-site water development and intensive management, the USFS believes the affected wetlands would be enhanced with the return of the natural flows while being grazed.

3.4.6.3.2 Moist Meadow. Moist meadow wetlands in the North Fields area would not be impacted by the Proposed Action because groundwater elevations would not change from baseline levels.

3.4.6.3.3 Emergent Marsh. A total of 6.8 acres of emergent marsh are situated in the area affected by lower groundwater elevations after converting from flood to sprinkler irrigation under the Proposed action (Map A-4 in pocket at back of EIS shows locations and sizes of emergent marsh. These emergent marshes would not be impacted by the groundwater drawdown because they are all supported by a spring located on the downhill side of the Wasatch canal. It has been determined by field investigations and personal communication that the water supply is not seepage from the canal, because the landowner has clay-lined the downhill side of the canal to stop the water flow to these areas on his property. However, water continues to flow from the spring source supporting the wetlands.

Approximately 3.4 acres of emergent marsh wetlands would be created at the Daniel reservoirs No. 1 and No. 3 in the upper Strawberry River basin by breaching and stabilizing the existing dams and lowering the water levels to create emergent marsh wetland vegetation and soils. The reservoir water levels are now too high to sustain persistent emergent vegetation.

3.4.6.3.4 Shrub Wetland. The USFS estimates that the return of flows to 6.3 miles of dry streams in the upper Strawberry River basin would create 2.6 acres of shrub wetland by supplying water to support willows and riparian understory vegetation adjacent to the streams. The 2.6 acres of wetland would be created along sections of the Strawberry River, Bjorkman Creek, Willow Creek and Hobble Creek (See Map 3-6). These stream sections contain areas where previous wetlands have become nonfunctional, and in most cases have been replaced by upland vegetative communities. This degradation has occurred because of lowered water tables resulting from water being diverted into the DIC canals for many years.

The 2.6-acre figure was derived by USFS specialists who surveyed the area and estimated the response the vegetation would have when permanent water is restored to the area. These estimates are based on past USFS experience with similar situations in Strawberry Valley.

The Proposed Action does not include planting shrubs. The USFS has requested funding from the Mitigation Commission to plant willows on several streams in Strawberry Valley, including the streams named above. But funding has not been approved at this time.

An additional 33.6 acres of shrub wetland that now receive water only during spring runoff also would be enhanced by the return of year-around flows, which would increase moisture to support healthy willow stands and wetland understory vegetation (See Map 3-6). These shrub wetlands have a healthy stand of willows but the understory vegetation is predominantly upland species. The willows are old enough that when the water is removed from the river, their roots tap into the water below the surface. The understory vegetation usually associated with wetlands is lacking because the water table drops out of the reach of the root zone when the river is diverted into the canals. The return of natural flows would maintain a higher water table, allowing he wetland understory vegetation to become re-established.

3.4.6.3.5 Riparian Woodland. Construction of the Wasatch Canal diversion would result in the loss of 11 box elder trees and one cottonwood tree adjacent to the Provo River.

A total of 4.6 acres of riparian woodland are located in the area that would be affected by lower groundwater elevations after converting from flood to sprinkler irrigation under the Proposed action. (Map A-4 in pocket at back of EIS shows locations and sizes of these riparian woodland areas. After reviewing these areas in the field on April 2, 1996, it was determined they would not be impacted by the potential groundwater elevation drawdown because they are all supported by water from ditches and canals, and the water supplies would not change under the Proposed Action.

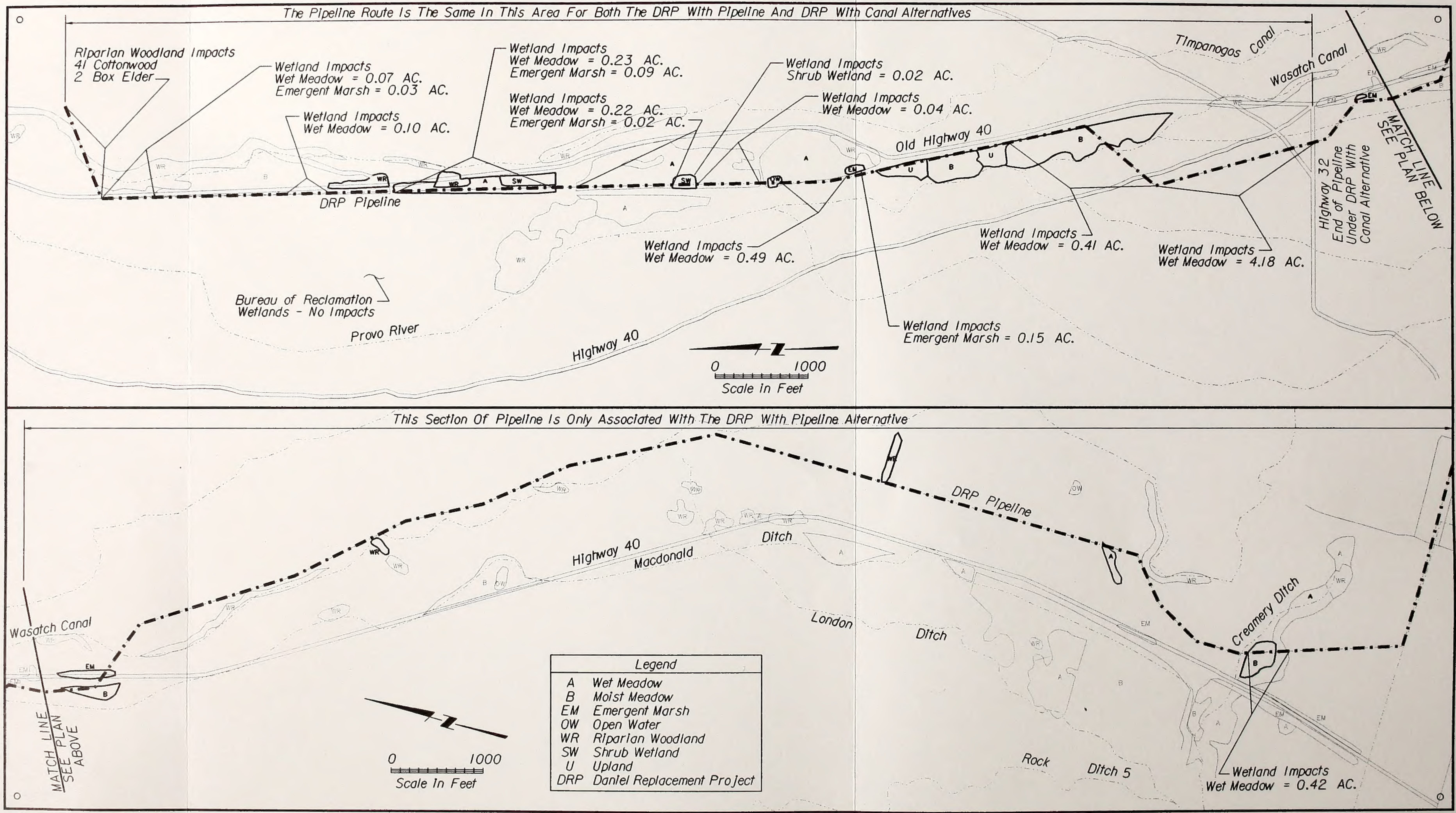
Existing riparian woodland along Daniels Creek would not be significantly impacted by termination of trans-basin flows from the upper Strawberry River basin because flows from existing springs, seeps and tributaries along the Daniels Creek corridor would provide sufficient water to sustain the riparian woodland vegetation. A considerable amount of beaver activity along Daniels Creek also impounds water that helps maintain riparian wetlands. Baseline flows and flows that would remain in Daniels Creek after removing the transbasin diversion are discussed in Sections 3.2, Water Resources.

The USFS estimates that abandoning and removing the DIC diversion facilities in the upper Strawberry River basin would indirectly affect 2.1 acres of riparian woodland wetlands associated with the existing canal system. These wetlands, which are found in small dispersed patches along the canals, would no longer receive water through canal seepage, and therefore would have no water supply other than precipitation.

3.4.6.3.6 Impact Summary. About 20.7 acres of wetlands in Heber Valley would be indirectly converted to upland by lower groundwater elevations under the Proposed Action. About 2.1 acres of riparian woodland would be converted to upland in the upper Strawberry River basin from eliminating flows in existing canals. Other wetlands would be enhanced in the upper Strawberry River basin. Table 3-27 summarizes adverse and beneficial wetland impacts by wetland type and acreage.

3.4.6.4 Daniel Replacement Project With Pipeline

Construction of the 36-inch pipeline under the DRP With Pipeline Alternative would temporarily disturb about 6.9 acres of wetlands adjacent to the old Highway 40 road alignment below Jordanelle Dam and on the east side of Highway 40, just north of Heber City (see Map 3-7). Wetland types that would be disturbed include wet and moist meadows, emergent marsh and shrub wetlands. Disturbance to



Map 3–7
Wetland Impacts Under the DRP With Pipeline and DRP With Canal Alternatives

wetlands would result from maneuvering construction equipment and excavating a trench to construct the pipeline that would begin at the Timpanogos Canal diversion and extend to the north end of Heber City (see general locations of impacted wetlands on Map 3-7). Details of the pipeline construction are documented in Chapter 1 of this EIS. Wetland impacts from the DRP With Pipeline Alternative would be short-term because disturbed areas would be reclaimed after construction is completed. There would be no impacts to the USBR mitigation wetlands from construction of the pipeline, which would occur on the east side of old Highway 40. The USBR wetlands are located on the west side of the highway. About 2.1 acres of wetlands along existing canals in the upper Strawberry River basin would be eliminated, while other wetlands in the upper Strawberry River basin would be enhanced and created.

3.4.6.4.1 Wet Meadow. Construction of the DRP With Pipeline Alternative would cause direct, short-term disturbance of wetland vegetation, soils and hydrology on a total of 6.6 acres of wet meadow. The wet meadows along old Highway 40 receive water from a drainage ditch that runs along the west edge of the wetlands about 100 feet from the edge of the road embankment, and from field drainage that collects along the embankment. The wet meadows just north of Heber City receive water from hillside springs and Creamery Ditch and are dominated by sedges and rushes. Wet meadow functions that would be temporarily impacted include groundwater recharge and sediment stabilization. The disturbance would be restored under the SOPs after 2 full growing seasons.

Approximately 3.4 acres of emergent marsh wetlands would be created at the Daniel reservoirs No. 1 and No. 3 in the upper Strawberry River basin by breaching and stabilizing the existing dams and lowering the water levels to create emergent marsh wetland vegetation and soils as described for the Proposed Action in Section 3.4.6.3.1.

3.4.6.4.2 Emergent Marsh. Construction of the DRP With Pipeline Alternative would cause direct, short-term disturbance to wetland vegetation, soils and hydrology on 0.3 acre of emergent marsh from construction equipment maneuvering to lay the pipeline. Wetland functions that would be temporarily reduced include groundwater discharge, sediment stabilization and wildlife diversity. The temporary disturbance to wet meadows would be restored under the SOPs. Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin would have the same impacts as described for the Proposed Action in Section 3.4.6.3.3.

3.4.6.4.3 Shrub Wetland. Construction of the DRP With Pipeline Alternative would cause direct, short-term disturbance to wetland vegetation, soils and hydrology on 0.02 acre of shrub wetland from construction equipment maneuvering to lay the pipeline. Wetland functions that would be temporarily impacted include groundwater discharge, sediment stabilization and wildlife abundance/diversity. The temporary disturbance to wet meadows would be restored under the SOPs.

The USFS estimates that the return of flows to 6.3 miles of dry streams in the upper Strawberry River basin would create 2.6 acres of shrub wetland by supplying water to support willows and riparian understory vegetation adjacent to the streams. An additional 33.6 acres of shrub wetland that now receive water only during spring runoff also would be enhanced by the return of year-around flows, which would increase moisture to support healthy willow stands.

3.4.6.4.4 Riparian Woodland. Impacts on riparian woodland under this alternative from the removal of trans-basin flows in Daniels Creek would be the same as described for the Proposed Action in Section 3.4.6.3.5. Adverse and beneficial impacts from abandoning and removing the DIC diversion facilities in the upper Strawberry River basin would be the same as described for the Proposed Action in Section 3.4.6.3.5.

3.4.6.4.5 Impact Summary. Table 3-28 summarizes wetland impacts and enhanced wetlands by wetland type and acreage. Direct adverse impacts would be restored under the SOPs.

3.4.6.5 Daniel Replacement Project With Canal Alternative

Construction of the DRP With Canal Alternative would cause direct, short-term impacts on wetlands totaling 6.1 acres. Wetland types that would be impacted include wet and moist meadows, emergent marsh, and shrub wetlands. The wetlands would be impacted by maneuvering construction equipment and excavating a trench to construct the 36-inch

Table 3-28
Summary of Adverse and Beneficial Wetland Impacts Under the Daniel Replacement Project With Pipeline Alternative

Impact Type	Wet Meadow (acres)	Emergent Marsh (acres)	Riparian Woodland (acres)	Shrub Wetland (acres)	Total (acres)
Temporary direct adverse impacts along pipeline corridor restored under SOPs	6.6	0.3	0	0.02	6.9
Indirect adverse impacts — Heber Valley and upper Strawberry River Basin	0	0	2.1	0	-2.1
Wetlands created in upper Strawberry River basin	0	3.4	0	2.6	6.0
Enhanced wetland quality and functions — upper Strawberry River basin	36.8	0	0	33.6	+70.4
Net change in wetland acres* — Heber Valley and upper Strawberry River basin	+36.8	+3.4	-2.1	+36.2	+74.3

Note:

*The 6.9 acres of direct adverse impacts that would be restored under the SOPs are excluded from the calculation to figure net change in wetland acres.

pipeline that would begin at the Timpanogos Canal diversion and extend to Highway 32 (see general locations of impacted wetlands on Map 3-7). There would be no impacts to the USBR mitigation wetlands from construction of the pipeline, which would occur on the east side of old Highway 40. The USBR wetlands are located on the west side of the highway. Details of the pipeline construction are documented in Chapter 1 of this EIS.

Wetland impacts from the DRP With Canal Alternative would be short-term because disturbed areas would be reclaimed after construction is completed. Wetland restoration would be the same as described under the DRP With Pipeline Alternative in Section 3.4.6.4.

Sections of the Timpanogos Canal that leak and supply water for downslope wetlands would not be lined as part of the canal rehabilitation and there would be no change in existing wetland area from the canal rehabilitation.

3.4.6.5.1 Wet Meadow Complex. A total of 5.8 acres of wet meadow wetlands would be indirectly impacted under the DRP With Canal Alternative. The pipeline size and route would be the same as the DRP With Pipeline Alternative, except the pipeline would be terminated at Highway 32 under this alternative.

Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin would have the same impacts as described for the Proposed Action in Section 3.4.6.3.1.

3.4.6.5.2 Emergent Marsh. Impacts from construction of the DRP With Canal Alternative would be the same as described in Section 3.4.6.4.2.

Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin would be the same as described for the Proposed Action (Section 3.4.6.3.3).

3.4.6.5.3 Shrub Wetland. Impacts from construction of the DRP With Canal Alternative would be the same as described in Section 3.4.6.4.3.

3.4.6.5.4 Riparian Woodland. Impacts on riparian woodland under the DRP With Canal Alternative from the termination of trans-basin flows in Daniels Creek would be the same as described for the Proposed Action in Section 3.4.6.3.5.

Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin would be the same as described for the Proposed Action (Section 3.4.6.3.5).

3.4.6.5.5 Impact Summary. Table 3-29 summarizes wetland impacts and enhanced wetlands by wetland type and acreage. Direct adverse impacts would be restored under the SOPs.

3.4.6.6 No Action Alternative

The No Action Alternative would have no impacts on existing wetlands. Flows would continue in Daniels Creek that support riparian vegetation. Wetlands along the DIC diversion facilities in the upper Strawberry River basin would not be impacted and wetlands associated with Daniel reservoirs No. 1 and No. 3 would not be created. Wetlands along the streams of the upper Strawberry River basin would not be enhanced because natural stream flows would not be restored.

Table 3-29
Summary of Adverse and Beneficial Wetland Impacts
Under the Daniel Replacement Project With Canal Alternative

Impact Type	Wet Meadow (acres)	Emergent Marsh (acres)	Riparian Woodland (acres)	Shrub Wetland (acres)	Total (acres)
Temporary direct adverse impacts along pipeline corridor restored under SOPs	5.8	0.3	0	.02	6.1
Indirect adverse impacts — Heber Valley and upper Strawberry River basin	0	0	2.1	0	-2.1
Wetlands created in upper Strawberry River basin	0	3.4	0	2.6	6.0
Enhanced wetland quality and functions — upper Strawberry River basin	36.8	0	0	33.6	+70.4
Net change in wetland acres*	+36.8	+3.4	-2.1	36.2	+74.3

Note:

*The 6.1 acres of direct adverse impacts that would be restored under the SOPs are excluded from the calculation to figure net change in wetland acres.

3.5 Aquatic Resources

The information and analysis documented in this section was summarized from the Draft Aquatic Resources Technical Report (CUWCD 1996a), which is available from CUWCD upon request. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.2.4.

3.5.1 Introduction

The aquatic resources analysis addresses potential impacts on aquatic resources from the construction, operation and maintenance of the Proposed Action and alternatives. The focus of the analysis is on game fish and their habitat, non-game fish and their habitat, and other aquatic resources. The following aquatic resources impact topics are addressed in the impact analysis:

- Game fish (trout) and their habitat
- Non-game fish and their habitat, including potential impacts on aquatic species of special concern
- Other aquatic resources (i.e., amphibians and macroinvertebrates)

3.5.2 Issues Eliminated From Further Analysis

None of the aquatic resources issues raised during scoping and defined in Section 3.5.4 have been eliminated from further analysis.

3.5.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- How would eliminating the transbasin diversion (reduction of flows) and the subsequent restoration of natural stream flows affect aquatic resources in upper Daniels Creek?
- Could adequate fish habitat be maintained in Daniels Canyon without the transbasin diversion from the Strawberry River basin?
- What impacts would occur on aquatic resources from restoring instream flows to Heber Valley tributary streams?

3.5.4 Description of Impact Area of Influence

The impact area of influence for evaluating potential aquatic resource impacts of the Proposed Action and alternatives includes Heber Valley streams or reaches selected to receive target supplemental instream flows; Daniels Creek reaches that would lose flow as a result of the elimination of transbasin diversions; and the upper Strawberry River and its tributaries upstream of Strawberry Reservoir that would gain flow as a result of the elimination of transbasin diversions.

The stream flow changes in the lower Provo River would be so minor that potential impacts on aquatic resources would not be measurable. Therefore, the lower Provo River was not included in the impact area of influence for aquatic resources.

The impact area of influence is described in the following sections and shown on Map 3-1 in Section 3.1.1.1.

3.5.4.1 Heber Valley and Daniels Creek

The Heber Valley impact area of influence includes the Provo River between Jordanelle and Deer Creek reservoirs and the following streams that would receive target supplemental instream flows (see Map 3-1):

- Creamery Ditch
- London Ditch
- Lower Lake Creek
- Rock Ditch
- Spring Creek

The upper reaches of Lake Creek would not receive supplemental instream flows under the Proposed Action or alternatives. These reaches are included in the analysis since they could be indirectly affected by potential changes occurring in the downstream reach.

The Provo River between Jordanelle and Deer Creek reservoirs and its tributaries would experience flow changes from Jordanelle Reservoir releases and the supplemental flows added to the five streams listed above.

Daniels Creek begins in upper Daniels Canyon and flows in a northwestern to western direction into Heber Valley before it enters Deer Creek Reservoir. Flows in upper Daniels Creek would be reduced by eliminating the transbasin diversion from the upper Strawberry River basin and related changes in DIC diversions from Daniels Creek. The impact area of influence includes the reach of upper Daniels Creek from where the transbasin diversion enters the creek downstream to the DIC diversion and the reach below the DIC diversion downstream to Deer Creek Reservoir.

3.5.4.2 Upper Strawberry River Basin

The following streams, collectively referred to as the upper Strawberry River basin, are included in the impact area of influence:

- The upper Strawberry River from the DIC diversion to Strawberry Reservoir
- Willow Creek
- Hobble Creek near Daniels Creek divide
- The stream in Bjorkman Hollow
- The stream in Point of Pines Canyon
- The stream in Murdock Hollow

Flows to approximately 34.5 miles of these streams would be restored under the Proposed Action and alternatives after the transbasin diversion is terminated. Other tributaries of the upper Strawberry River (including Clyde Creek and Co-op Creek) and the river above the DIC diversion are included in the impact area of influence because they may be indirectly affected as a result of restored flows.

3.5.5 Affected Environment (Baseline Conditions)

This section defines the aquatic resources environment that would be affected by the Proposed Action and alternatives. The affected environment of the aquatic resources is the same as baseline conditions, which were defined through field surveys conducted by Woodward-Clyde Consultants in 1993. These survey methods are described in Appendix B, Section B.2.4.2.1.1.

3.5.5.1 Game Fish and Their Habitat

Four species of game fish were identified from field surveys within the impact area of influence, including brown trout, cutthroat trout, rainbow trout, and mountain whitefish (see Table 3-30). Most of these game fish species prefer relatively cool water (55 to 62 °F) and live in streams throughout the Intermountain West. Cutthroat trout generally are found in relatively steeper, headwater streams compared to brown and rainbow trout, which typically are found in lower-elevation reaches. The following subsections describe the game fish present in the impact area of influence, baseline habitat quality attribute ratings, and baseline predicted trout standing crop. Habitat quality attributes and ratings are described in Appendix B, Section B.2.4.2.1.2. Trout standing crop is the total weight of trout per unit area of water.

3.5.5.1.1 Baseline Game Fish Occurrence. Brown trout, the predominant game fish collected during surveys in the Heber Valley and Daniels Creek, were present in every stream reach sampled except the uppermost reach of Daniels Creek. Cutthroat trout were collected only in the upper reaches of Daniels Creek within the Heber Valley portion of the impact area of influence, but were the predominant game fish reported in the upper Strawberry River basin before the 1990 rotenone treatment of Strawberry Reservoir, which eliminated all fish. Cutthroat trout were subsequently restocked into the Strawberry River and tributaries, and some were observed during reconnaissance visits to the upper Strawberry River and Willow Creek during the summer of 1995. It is likely they are present in the tributaries of the upper Strawberry River where suitable habitat exists. Rainbow trout were present in most of the streams sampled in Heber Valley, but not in all reaches within a stream. Mountain whitefish were only collected within the Provo River and Spring Creek.

3.5.5.1.2 Baseline Habitat Quality Attribute Ratings. The Binns HQI Model II baseline habitat attribute ratings (described in Appendix B, Section B.2.4.2.1.2) were developed during field surveys and include quantitative measurements as well as best professional judgment. The overall results of the baseline ratings are shown on Table 3-31 and described in the following paragraphs.

Table 3-30
Fish Species Collected in Heber Valley and Upper Strawberry River Basin Streams

Common Name	Scientific Name	Location of Occurrence				Game (G) or Non-Game (NG)
		H[1]	D[2]	US[3]	P[4]	
Brook trout	*Salvelinus fontinalis*			X		G
Brown Trout	*Salmo trutta*	X	X		X	G
Cutthroat Trout	*Oncorhynchus clarki*		X	X		G
Rainbow Trout	*Oncorhynchus mykiss*	X	X	X	X	G
Mountain Whitefish	*Prosopium williamsoni*	X			X	G
Leatherside Chub	*Gila copei*	X		X	X	NG
Utah Chub	*Gila atraria*			X		NG
Longnose Dace	*Rhinichthys cataractae*	X			X	NG
Speckled Dace	*Rhinichthys osculus*	X		X		NG
Redside Shiner	*Richardsonius balteatus*	X		X	X	NG
Mountain Sucker	*Catostomus platyrhynchus*	X		X	X	NG
Utah Sucker	*Catostomus ardens*	X		X	X	NG
Mottled Sculpin	*Cottus bairdi*	X	X	X	X	NG

Notes:

Source: CUWCD 1993a, Utah Division of Wildlife Resources (1984, 1985, 1986)
[1]H = Heber Valley streams planned to receive target supplemental instream flows
[2]D = Daniels Creek reaches DC-04, DC-05, DC-06
[3]US = Upper Strawberry River and tributaries above Strawberry Reservoir. This information reflects conditions before the 1990 rotenone treatment of Strawberry Reservoir, and is presented here for informational purposes only.
[4]P = Provo River from Jordanelle Dam downstream to Deer Creek Reservoir

Most Heber Valley streams received habitat attribute ratings of 3 to 4 for late summer stream flow. Late summer stream flow is one of the most important attributes in the calculation of predicted trout standing crop, and influences the other habitat ratings that are directly related to instream flow (i.e., annual stream flow variation, maximum summer stream temperature, current velocity, and wetted channel width). Streams with low ratings for late summer stream flow generally had low ratings for these other attributes.

Fish cover was rated low for all of the streams and stream reaches, indicating poor riparian cover and instream structure as a general characteristic of Heber Valley streams. Lower Lake Creek and Creamery Ditch had extensive areas of eroding stream banks and received low baseline ratings for this attribute. Spring Creek, London Ditch and one reach of Rock Ditch had generally good conditions relative to bank erosion.

3.5.5.1.3 Baseline Predicted Trout Standing Crop. Numerical values for the baseline habitat quality attribute ratings summarized in Section 3.5.5.1.2 were used to calculate baseline predicted trout standing crop in the impact area of influence (Table 3-32). Spring Creek and Rock Ditch generally had the highest predicted trout standing crop in Heber Valley. London Ditch and lower Lake Creek had relatively low predicted trout standing crop. Both reaches of upper Daniels Creek had moderate predicted trout standing crop compared to Heber Valley streams.

Table 3-31
Baseline Habitat Ratings and Predicted Trout Standing Crop for Heber Valley Streams

	Habitat Attribute Rating*									Predicted Trout Standing Crop (pounds/acre)
Stream/Reach	**X1**	**X2**	**X3**	**X4**	**X7**	**X8**	**X9**	**X10**	**X11**	
Spring Creek										
SP-01	2	2	3	3	0	4	2	4	3	64.85
SP-02	4	4	3	3	1	3	1	3	4	134.61
SP-03	3	2	4	3	0	2	3	1	2	70.23
Creamery Ditch										
SP-04	4	3	4	2	0	2	1	4	3	101.11
London Ditch										
SP-05	4	4	4	4	1	4	0	2	2	19.40
Rock Ditch										
RC-01	3	2	4	1	1	2	3	2	3	78.26
Lower Lake Creek										
LC-01	1	1	4	1	0	0	1	3	2	13.75
Daniels Creek										
DC-05	3	3	3	1	1	3	1	3	3	45.37
DC-06	3	2	3	4	2	2	1	1	2	40.71

Notes:

Source: CUWCD 1993b

*Habitat Attribute Ratings range from 0 (worst) to 4 (best) (see Section B.2.4.2.1.2 in Appendix B for description):

X1-Late summer stream flow
X2-Annual stream flow variation
X3-Maximum summer stream temperature
X4-Nitrate-nitrogen
X7-Fish cover
X8-Eroding stream banks
X9-Submerged aquatic vegetation
X10-Current velocity
X11-Wetted channel width

Table 3-32
Baseline Stream Area, Predicted Trout Standing Crop and Trout Biomass in the WCWEP and DRP Impact Area of Influence

Stream/ Reach	Reach Length (feet)	Average Width (feet)	Surface Area (acres)	Baseline Predicted Trout Standing Crop[a] (pounds/acre)	Baseline Trout Biomass[b] (pounds)
Spring Creek/ SP-01	3,570	15.4	1.3	64.85	84.31
Spring Creek/ SP-02	3,550	22.0	1.8	134.61	242.30
Spring Creek/ SP-03	7,000	8.1	1.3	70.23	91.30
Creamery Ditch/ SP-04	3,560	13.8	1.1	101.11	111.22
London Ditch/ SP-05	7,310	10.0	1.7	19.40	32.98
Rock Ditch/ RC-01	7,145	12.4	2.0	78.26	156.52
Lower Lake Creek/ LC-01	3,070	10.8	0.8	13.75	11.00
Daniels Creek/ DC-05	47,520	15.0	16.4	45.37	744.07
Daniels Creek/ DC-06	15,840	7.6	2.8	40.71	113.99
Upper Strawberry River[c]	no data[d]	no data	no data	no data	1,819
Overall Strawberry Valley[c]	no data	no data	no data	no data	21,906

Note:

[a] Values derived using the Binns HQI Model II (see Secton B.2.4.2.1.2 in Appendix B for description).

[b] Surface Area (acres) x Trout Standing Crop (pounds/acre) = Trout Biomass (pounds) = the total weight of trout in the stream reach.

[c] Upper Strawberry River and overall Strawberry Valley trout biomass data from Mills (1984)

[d] No data were collected.

3.5.5.2 Non-Game Fish and Their Habitat

Eight non-game species of fish were identified from field surveys within Heber Valley streams (Table 3-30). These include the leatherside chub, longnose dace, speckled dace, redside shiner, mountain sucker, Utah sucker and mottled sculpin. The leatherside chub is of particular concern because it is a species of special status. The non-game species reported in the upper Strawberry River basin reflect conditions before the 1990 rotenone treatment of Strawberry Reservoir which eliminated all fish. Recently, speckled dace and mottled sculpin were reintroduced to the upper Strawberry River basin, but no quantitative information is available for these species.

Mottled sculpin, speckled dace and redside shiner were the most commonly collected non-game fish during field surveys in Heber Valley streams. Except for leatherside chub and Utah sucker, the non-game species collected generally have comparable habitat preferences to the game fish species described in Section 3.5.5.1.1. Specific habitat preferences may vary, but the distribution of these non-game species typically overlap with trout in streams of the Intermountain West.

Leatherside chub, which were collected in Lake Creek, Spring Creek and the Provo River, are medium-sized minnows, seldom exceeding 6 inches in length, that live about 8 years. Leatherside chub are listed as species of special concern by the Utah Division of Wildlife Resources. Leatherside chub has a rank of S3 — uncommon or rare — in the Utah Natural Heritage Program Species of Special Concern Summary (Utah Division of Wildlife Resources 1995). The reasons for the decline of the leatherside chub are not well understood, but likely include dewatering of streams, predation from introduced species and changes in water quality due to human influences (Shirley 1989 and 1993, Holden et al. 1994).

Very little is known about the habitat preferences of the leatherside chub, however, the historic distribution of this species suggests a "cool" water preference. Based on collections by Woodward-Clyde Consultants (CUWCD 1993b) during Heber Valley field surveys they are usually found in areas characterized by cobble/gravel substrates, low to medium velocity, warm late-summer temperatures and some turbidity. It is unclear whether the chub prefer this type of habitat or are driven there by competition or predation by trout and other cold-water species. compared to the "cold" water preference.

Baseline estimates of non-game fish standing crop were not prepared because data were not collected or available.

3.5.5.3 Other Aquatic Resources

Other aquatic resources include benthic macroinvertebrates (aquatic insects) and amphibians (frogs, salamanders). No specific field surveys were conducted for either of these two groups except for the spotted frog, which is a Category-1 candidate threatened and endangered species (see Section 3.7, Threatened and Endangered Species). A Category-1 candidate is a species proposed for listing in the Federal Register under the ESA.

Benthic macroinvertebrates are an important source of food for both game and non-game fish species. The habitat attribute rating for submerged aquatic vegetation is an indicator of the quantity of fish food available in a stream, primarily in the form of benthic macroinvertebrates (Binns 1982). In fact, the habitat attribute rating is an attempt to estimate the expected density of aquatic macroinvertebrates. This habitat attribute was assigned ratings of less than 3 (on a scale of 0 to 4) for all Heber Valley stream stations except Spring Creek (SP-03) and Rock Ditch. This indicates that the presence of macroinvertebrates is generally moderate to poor in most of the streams. Spring Creek (SP-03) and Rock Ditch had habitat attribute ratings of 3, indicating good conditions for macroinvertebrates.

There is no specific information on amphibian presence in the impact area of influence (except as described for the spotted frog in Section 3.7). Several amphibian species are year-round residents of the Provo River corridor, and their presence is likely within some of the other streams within Heber Valley and the upper Strawberry River basin. These species include the Woodhouse toad (*Bufo woodhousei*), leopard frog (*Rana pipiens*), boreal chorus frog (*Pseudacris triseriata maculata*), and tiger salamander (*Ambystoma tigrinum*). All are associated with riparian areas of ponds, marshes and streams.

3.5.6 Impact Analysis

3.5.6.1 Significance Criteria

The aquatic resources significance criteria are based on the Binns HQI Model II results, professional judgment and contacts with state officials. The following types of impacts on aquatic resources and their habitat would be considered significant:

- Impacts on game fish and their habitat resulting from instream construction activities that occur within any spawning areas or cause sedimentation in any spawning areas
- A decrease in the Binns HQI Model II habitat attribute ratings compared to baseline conditions within the impact area of influence
- A decrease in the Binns HQI Model II predicted trout standing crop compared to baseline conditions within the impact area of influence

Although the Binns HQI Model II standing crop predictions apply specifically to trout, the habitat attribute ratings also apply generally to non-game fish and other aquatic resources. The habitat attribute results were used to qualitatively assess the significance of potential impacts on non-game fish and other aquatic resources.

3.5.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential aquatic resources impacts have been eliminated from further analysis.

3.5.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following subsections describe potential impacts on aquatic resources during construction and operation of the Proposed Action. The impact area of influence is shown on Map 3-1 in Section 3.1.1.1 Map A-1 (see pocket at back of EIS) provides more detail on the Proposed Action in Heber Valley, and Map 1-4 in Chapter 1, Section 1.8.7 provides more detail on the Proposed Action in the upper Strawberry River basin.

3.5.6.3.1 Game Fish and Their Habitat. The following subsections describe impacts on game fish and their habitat from construction and operation of the Proposed Action.

3.5.6.3.1.1 Impacts During Construction. The Proposed Action would result in the construction of several facilities within streams in the impact area of influence, including the Provo River, Rock Ditch and Spring Creek. The following facilities would be constructed:

- A reconstructed Timpanogos diversion structure located near the afterbay of the Jordanelle Dam in the old Provo River channel (see Section 1.8.2.1.1).
- Two new flow control structures on Rock Ditch to allow supplemental instream flows to pass existing irrigation diversions (see Section 1.8.5).
- One new flow control structure on Spring Creek to allow supplemental instream flows to pass existing irrigation diversions (see Section 1.8.5).

Potential impacts on game fish and their habitat resulting from construction of the facilities listed above are described in the following paragraphs.

Reconstruction of the Timpanogos Diversion would involve placement of a new concrete sill in the old Provo River Channel at the same location occupied by the existing concrete sill and flashboards. Minor erosion and sedimentation would occur during the reconstruction, which would result in increased turbidity levels downstream of the construction area.

Construction of the two new flow controls structures in Rock Ditch would occur in the year prior to providing supplemental instream flows to Rock Ditch. As a result, there would be no impacts on game fish and their habitat from construction of two new flow control structures in Rock Ditch.

Construction of the new flow control structure in Spring Creek would occur at the head of the Sagebrush and Spring Creek Canal (see Map A-1). Construction would occur before providing supplemental instream flows, but some water would be present from the inflow from perennial spring sources. No fish spawning areas are reported at or downstream of this location in Spring Creek. However, construction timing would still avoid the period of fish spawning activity and egg development. Construction would cause increased turbidity from sediment disturbance, but it would be minimized downstream through by using erosion control features such as sediment fences. The construction area would be stabilized using the SOPs described in Section 1.12.9.1 for erosion control and revegetation. As a result, only minor turbidity impacts would occur. No significant impacts would occur to game fish or their habitat.

In general, implementation of the SOPs listed for aquatic resources, revegetation and erosion control (see Section 1.12.9 in Chapter 1 of this EIS) would eliminate the impacts of instream construction on aquatic resources or reduce the impacts to minor levels. No significant impacts on game fish and their habitat would occur as a result of instream construction.

Since no construction activities would occur in Daniels Creek under the Proposed Action, there would be no impacts on game fish and their habitat.

There is potential for increased turbidity in streams associated with the abandonment and removal of DIC diversion facilities in the upper Strawberry River basin. Turbidity would increase noticeably as the DIC diversion facilities are removed and sediments become suspended in the water column. The increased turbidity has the potential to impact spawning areas of cutthroat trout (spring spawners) or kokanee (fall spawners) depending on the season of construction and the amount of flow in the stream.

Cutthroat trout spawning areas occur in the reaches of the upper Strawberry River tributaries where the DIC diversion facilities would be abandoned and removed. Abandonment and removal during the spring to early summer could cause sedimentation of cutthroat trout spawning gravels where eggs and/or fry are developing, which would result in a significant impact on game fish and their habitat.

Kokanee could be present in the upper Strawberry River tributaries during the fall of a wet year when relatively high stream flow allowed access. Abandonment and removal of the DIC facilities during the fall could cause sedimentation in kokanee spawning areas. This would result in a significant impact on game fish and their habitat as a result of sedimentation in spawning areas.

3.5.6.3.1.2 Impacts During Operation. The primary impacts on aquatic resources associated with operation of the Proposed Action would result from changes in instream flows compared to baseline conditions. Minor operations activities would occur in the upper Strawberry River basin to maintain the reclaimed areas and facilities. The primary impact would result from the restoration of natural instream flows in the affected streams. Elimination of transbasin diversions from the upper Strawberry River basin would reduce flows in upper Daniels Creek while restoring natural stream flow levels to approximately 34.5 miles of streams within the upper Strawberry River basin. Operation of the Proposed Action would provide supplemental instream flows to a number of streams within Heber Valley.

The elimination of transbasin diversion flow in upper Daniels Creek would result in a decrease in the predicted trout standing crop and trout biomass compared to baseline conditions in reaches DC-05 and DC-06. Binns HQI Model II estimates showed reductions of 81 and 96 percent in predicted trout standing crop and trout biomass in reaches DC-05 and DC-06, respectively (Table 3-33). The stream flow loss would primarily affect cutthroat trout, but brown and rainbow trout would also be affected. This would cause adverse impacts on natural trout production in reaches DC-05 and DC-06 of Daniels Creek since there would be a net decrease in game-fish habitat compared to baseline conditions.

However, the Utah Division of Wildlife Resources would continue to annually plant approximately 2,500 pounds of catchable rainbow trout in Daniels Creek reaches DC-05 and DC-06 to support a put-and-take trout fishery at a level comparable to baseline conditions. The biomass of fish stocked through this program is approximately 1,787 pounds more than the predicted decrease in trout biomass from lost natural production (2,500 pounds - 713 pounds = 1,787 pounds). Management of this stream for a put-and-take fishery at levels comparable to baseline would compensate for the predicted losses in game-fish standing crop and biomass from natural production. Therefore, there would be no significant impacts on game fish or their habitat in upper Daniels Creek.

There would be no change or only a slight decrease in water temperature in upper Daniels Creek during late summer and fall since relatively warm water from the south facing slopes of the upper Strawberry

Table 3-33
Summary of Changes in Predicted Trout Standing Crop and Biomass from Baseline Conditions Under the Proposed Action (WCWEP With Daniel Replacement Pipeline)

Stream / Reach	Predicted Trout Standing Crop			Trout Biomass			Percent Change from Baseline (%)
	Baseline (lb/acre)	Proposed Action (lb/acre)	Change from Baseline (lb/acre)	Baseline (pounds)	Proposed Action (pounds)	Change from Baseline (pounds)	
Spring Creek SP-01	64.85	247.26	182.41	84.31	321.44	237.13	281
Spring Creek SP-02	134.61	134.61	-0-	242.30	242.30	-0-	-0-
Spring Creek SP-03	70.23	262.94	192.71	91.30	341.82	250.52	275
Creamery Ditch SP-04	101.11	173.51	72.40	111.22	190.86	79.64	72
London Ditch SP-05	19.40	341.19	321.79	32.98	580.02	547.04	1,658
Rock Ditch RC-01	78.26	320.59	242.33	156.52	641.18	484.66	312
Lower Lake Creek LC-01	13.75	34.65	20.90	11.00	27.72	16.72	323
Daniels Creek[a] DC-05	45.37	8.52	-36.85	744.07	139.73	-604.34	-81
Daniels Creek[a] DC-06	40.71	1.78	-38.93	113.99	4.98	-109.01	-96
Upper Strawberry River[b,c]	n/a[d]	n/a	n/a	1,819	18,437	16,618	914
Totals	n/a	n/a	n/a	3,406.69	20,927.05	17,520.36	514

Notes:

[a] Reduced trout standing crop and biomass in Daniels Creek would be compensated by annual planting of 2,500 pounds of catchable rainbow trout to maintain a put-and-take fishery at baseline levels.

[b] Upper Strawberry River includes the Strawberry River and its tributaries above Strawberry Reservoir (data from Mills 1984).

[c] Increased trout biomass in the upper Strawberry River basin as a result of terminating the DIC diversion is mitigation **for impacts of the** Strawberry Aqueduct **and** Collection System and **is made possible by** the Proposed Action (WCWEP With Daniel Replacement Pipeline).

[d] n/a = not applicable

River basin would be eliminated. Sediment and nutrient concentrations also are not predicted to change from baseline conditions in upper Daniels Creek based on water quality modeling for this reach of Daniels Creek. This is because land-use practices would not change and flows would decrease. As a result, no water quality-related habitat changes would occur, and there would be no water quality impacts on game-fish habitat.

Flow in Daniels Creek below the Lower Strawberry Canal (Reach DC-04 vicinity) could potentially increase by an average of 2,377 acre-feet per year as a result of reduced diversions by the Daniels Irrigation Company (DIC). Future diversion practices of DIC are unknown and they still would have the right to divert water from the Lower Strawberry Canal if desired even though the Proposed Action supplies replacement water to DIC. Any increased flow in Reach DC-04 would infiltrate into the bottom of the stream channel within 1 to 2 miles and not reach Deer Creek Reservoir directly by surface flow except during May and June. This flow would provide some additional habitat compared to baseline conditions for game fish in Reach DC-04 of Daniels Creek, but the increase is not quantifiable since this reach of Daniels Creek was dry during field surveys, and baseline habitat quality conditions were not determined.

Providing target supplemental instream flows in Rock Ditch, lower Lake Creek, Spring Creek, Creamery Ditch and London Ditch would improve habitat for game-fish species by providing year-round, optimal flow conditions compared to baseline conditions when the streams are dry during late summer and, in some years, the winter. Year-round optimal flow would provide increased production of aquatic macroinvertebrates (food for game fish); decrease annual stream flow variation; reduce late-summer water temperatures experienced during low-flow periods; and promote some increased growth of riparian vegetation through a constant water supply even with continued livestock grazing on the streambanks. All streams would have a predicted increase in trout standing crop, except Spring Creek station SP-02 (Table 3-33). Baseline conditions at this station on Spring Creek were near optimum, so no increase in benefits would be expected from providing target supplemental instream flows.

Overall, predicted trout biomass would increase by about 17,520 pounds over baseline conditions in the impact area of influence when the full potential of the improvements in aquatic habitat and trout production are realized (Table 3-33). This represents an increase of approximately 514 percent over baseline conditions. Trout species affected include cutthroat, brown and rainbow trout. The increase in trout standing crop and trout biomass as a result of the Proposed Action would be a positive impact on game fish and their habitat. It should be noted that increased trout biomass in the upper Strawberry River basin resulting from termination of the DIC diversion is mitigation for impacts of the Strawberry Aqueduct and Collection System and is made possible by the Proposed Action.

Positive fishery impacts would occur in additional streams in Heber Valley and the upper Strawberry River basin. In Heber Valley, streams connected to the Spring Creek system but not receiving target supplemental instream flows (such as upper Lake Creek) could have increased trout standing crop as fish move from the Spring Creek system into adjoining drainages. Such potential increases are difficult to quantify, however. In the upper Strawberry River basin, Co-op Creek, Clyde Creek and other tributaries of the upper Strawberry River would benefit indirectly through improved aquatic habitat in the Strawberry River. Improved conditions in the Strawberry River could provide fish refuge during natural low-flow periods in the smaller tributaries.

Management of streams within the impact area of influence for natural production, with no supplementation from hatchery sources (except as noted above for Daniels Creek), would require a number of years of successful trout reproduction and recruitment to reach the predicted production levels. The Final EIS for the Strawberry Valley Management Area estimated that it will take 15 to 20 years for natural trout production to reach full potential in the upper Strawberry River basin after eliminating the transbasin diversion (USFS 1990).

This estimate assumed implementation of management activities in the upper Strawberry River basin, such as stream rehabilitation and riparian zone revegetation, that are not part of the Proposed Action for Heber Valley streams receiving supplemental instream flows. Based on the analysis of the upper Strawberry River basin, the time period required to realize the full potential of Heber Valley streams is probably at least 15 to 20 years, if not more, since stream rehabilitation or riparian zone revegetation is not part of the Proposed Action.

Water releases from Jordanelle Reservoir to Heber Valley streams would reach equilibrium temperatures within about 330 feet downstream of the dam, according to water quality modeling of releases from Jordanelle Reservoir under worst-case, summer-temperature conditions. Since the point of diversion to Heber Valley streams receiving target supplemental instream flows is about 9,500 feet below Jordanelle Reservoir, there would be no effect on water temperatures in the streams receiving target supplemental flows from the Provo River (see Section 3.3). There would be no significant temperature-related impacts on the Provo River since the predicted rise in temperature within the 330-foot zone below Jordanelle Reservoir is within the optimal range for trout.

As a result of reduced diversions under the Proposed Action, flow in the Provo River below the Timpanogos Diversion is, on average, 7 cfs higher than under baseline conditions. Baseline conditions of flow in the Provo River at the Valeo Diversion, and downstream of this point, would not change under the Proposed Action. Based on these conclusions, no impacts on game fish and their habitat would occur in the Provo River as a result of the Proposed Action.

The Proposed Action would improve herbicide-related water quality in the Humbug Canal by increasing the slope (and water velocity) of the Humbug Canal, thus discouraging weed growth. The Proposed Action would also reduce the need for herbicide applications in areas where open canals would be replaced with buried pipelines, since no weeds would grow inside the pipeline in the absence of sunlight. In other canals and streams, the Proposed Action would not change herbicide concentrations because it is not expected to change herbicide application practices. Overall, there would be positive impacts on aquatic resources habitat as a result of changes in herbicide use associated with the Proposed Action in areas where herbicide use is reduced from baseline conditions. There would be no impact in areas where herbicide use is unchanged from baseline conditions.

3.5.6.3.2 Non-Game Fish and Their Habitat. The following subsections describe impacts on non-game fish and their habitat from construction and operation of the Proposed Action.

3.5.6.3.2.1 Impacts During Construction. The Proposed Action would not result in any impacts to non-game fish and their habitat during construction for the same reasons described in Section 3.5.6.3.1 for game-fish species and their habitat.

3.5.6.3.2.2 Impacts During Operation. Elimination of Strawberry River basin diversions would reduce flow in upper Daniels Creek. This would result in a decrease in habitat available for non-game fish species (primarily mottled sculpin), similar to that for game-fish species. Mottled sculpin were the only non-game fish species collected in upper Daniels Creek.

Adding target supplemental instream flows in Rock Ditch, lower Lake Creek, Spring Creek, Creamery Ditch and London Ditch would result in improved habitat for non-game fish that occupy similar habitat as trout, such as redside shiner, speckled dace and longnose dace. However, the habitat in these streams would be less suitable for other species such as the leatherside chub, which are reported to prefer streams with relatively slower velocity and relatively warmer temperatures compared to trout streams. This type of habitat exists in the areas where these fish were collected in portions of Spring Creek and the Provo River that have relatively low flows. Leatherside chub were found in Lake Creek, another stream that would receive target supplemental instream flows under the Proposed Action. Summer flows would increase to 23 cfs in Spring Creek and to 6 cfs in lower Lake Creek.

Leatherside chub also are relatively opportunistic species that could adapt to a variety of habitat conditions that may not necessarily represent preferred conditions. The predicted changes in habitat conditions in Heber Valley streams as a result of providing supplemental instream flows may produce habitat conditions less favorable to leatherside chub, but the change is not expected to result in significant adverse impacts on this species and some changes would benefit all species. For instance, providing year-round flows would benefit all aquatic resources, including leatherside chub, compared to baseline conditions where entire creeks or reaches of creeks go dry in the summertime.

Non-game fish production would increase and fish habitat would be improved in the upper Strawberry River basin streams because of restored flows. Increased flows could adversely affect leatherside chub populations by creating habitat conditions not preferred by this species. The presence of leatherside chub in the upper Strawberry River basin streams is not verified, and it is likely that the application of rotenone in 1990 eliminated these species along with most other fish species. This species is not native to the upper Strawberry River basin, and there are no current plans to reintroduce this species to this basin.

The Proposed Action would not cause adverse water quality impacts on the habitat of non-game species for the same reasons listed in Section 3.5.6.3.1 for game fish and their habitat.

3.5.6.3.3 Other Aquatic Resources. The following subsections describe impacts on other aquatic resources (i.e., amphibians and macroinvertebrates) from construction and operation of the Proposed Action.

3.5.6.3.3.1 Impacts During Construction. The Proposed Action would not result in any impacts on other aquatic resources during construction for the same reasons described in Section 3.5.6.3.1 for game fish species and their habitat.

3.5.6.3.3.2 Impacts During Operation. Elimination of Strawberry River basin diversions would reduce flow in upper Daniels Creek. This would result in a decrease in habitat available for other aquatic resources, similar to that for game-fish species.

Providing target supplemental instream flows in Rock Ditch, lower Lake Creek, Spring Creek, Creamery Ditch and London Ditch would result in improved habitat for other aquatic resources similar to that for game-fish species. Restored flows would increase production of aquatic macroinvertebrates, and possibly amphibians, and improve habitat in the upper Strawberry River basin.

3.5.6.3.4 Impact Summary. Elimination of transbasin diversion flows in upper Daniels Creek would result in a decrease in the natural production of game fish (primarily brown and cutthroat trout, but also rainbow trout) in Daniels Creek reaches DC-05 and DC-06. Planting of hatchery-produced rainbow trout to support a put-and-take fishery in upper Daniels Creek would compensate for the biomass of fish lost from the predicted decrease in natural production. Provision of supplemental instream flows to several Heber Valley streams would result in an increase in trout standing crop (primarily brown trout) and an increase in trout biomass. Elimination of the transbasin diversion and restoration of natural stream flows would result in an increase in cutthroat trout production in the upper Strawberry River basin. Overall, there would be a predicted increase of about 17,520 pounds of trout within the impact area of influence when the full potential of habitat quality and trout production is realized. This would be a positive impact of implementing the Proposed Action.

Optimal flows for trout are not conditions favored by the leatherside chub, which prefer relatively warm and slow-moving waters. The increased flows could adversely affect the leatherside chub and its habitat.

Elimination of Strawberry River basin diversions would reduce flow in upper Daniels Creek. This would result in a decrease in habitat available for non-game species and other aquatic resources, similar to that for game-fish species. Habitat for non-game species such as redside shiner, speckled dace, longnose dace, and suckers that typically co-occur with game species would receive benefits comparable to those described above for game fish species. These impacts are not considered significant.

Overall, the potential benefits to habitat quality of non-game species under the Proposed Action outweigh potential negative impacts of lowered habitat quality for a few species including the leatherside chub. The degree of change in habitat quality is not expected to result in significant impacts to leatherside chub and their habitat and some changes, such as providing year-round flow, will benefit all aquatic resources, including the leatherside chub. Providing supplemental instream flows would also result in improved instream and riparian zone habitat for other aquatic resources.

3.5.6.4 Daniel Replacement Project With Pipeline Alternative

The following subsections describe potential impacts on aquatic resources during construction and operation of the DRP With Pipeline Alternative. The impact area of influence is shown on Map 3-1 in Section 3.1.1.1. Map A-2 (see pocket at back of EIS) provides more detail on the DRP With Pipeline Alternative in Heber Valley.

3.5.6.4.1 Game Fish and Their Habitat. The following subsections describe impacts on game-fish and their habitat from construction and operation of the DRP With Pipeline Alternative.

3.5.6.4.1.1 Impacts During Construction. This alternative would not result in any construction activities in fish-spawning areas or cause siltation of spawning areas for the same reasons described for the Proposed Action in Section 3.5.6.3.1.1.

3.5.6.4.1.2 Impacts During Operation. Impacts on game-fish species in Daniels Creek and the upper Strawberry River basin under operation of this alternative would be the same as for the Proposed Action in Section 3.5.6.3.1.2. Overall, this alternative would result in a positive impact on game fish and their habitat from a predicted 467% increase in trout standing crop and biomass compared to baseline conditions (Table 3-34).

No target supplemental instream flows would be provided to Heber Valley streams under this alternative. Trout standing crop would likely continue at levels represented by baseline conditions for Spring Creek, Creamery Ditch, London Ditch, Rock Ditch and lower Lake Creek (Table 3-34).

Flows in the Provo River above Deer Creek Reservoir would be minimally affected by this alternative. In most reaches of the Provo River, average dry-year flows under this alternative would be unchanged from baseline conditions. During average and wet years, some reaches would have a maximum 1 percent decrease in flows, which is not significant in terms of flow in average and wet years. Negligible impacts on game fish and their habitat would result.

3.5.6.4.2 Non-Game Fish and Their Habitat. The following subsections describe impacts on non-game fish and their habitat from construction and operation of the DRP With Pipeline Alternative.

3.5.6.4.2.1 Impacts During Construction. This alternative would not result in any construction activities in fish-spawning areas or cause siltation of spawning areas for the same reasons as for the Proposed Action in Section 3.5.6.3.1.1.

3.5.6.4.2.2 Impacts During Operation. Impacts on non-game fish species in Daniels Creek and the upper Strawberry River basin during operation of this alternative would be the same as for the Proposed Action in Section 3.5.6.3.2.2. Non-game fish distribution and numbers would likely continue at levels represented by baseline conditions for Spring Creek, Creamery Ditch, London Ditch, Rock Ditch and lower Lake Creek because no target supplemental instream flows would be provided to these streams under this alternative.

The minor changes in flow on the Provo River described in Section 3.2.6.4.4 would not result in significant impacts on most non-game species. Potential impacts on leatherside chub and other species that prefer relatively warmer, low-current habitat would occur as a result of increased stream flows.

3.5.6.4.3 Other Aquatic Resources. The following subsections describe impacts on other aquatic resources from construction and operation of the DRP With Pipeline Alternative.

3.5.6.4.3.1 Impacts During Construction. This alternative would not result in any construction-related impacts for the same reasons as for the Proposed Action in Section 3.5.6.3.1.1.

3.5.6.4.3.2 Impacts During Operation. No supplemental instream flows would be provided to Heber Valley streams. Production of other aquatic resources would likely continue at levels represented by baseline conditions. There would be no potential impacts on aquatic resources from changes in herbicide use under this alternative because herbicide application rates would not change.

3.5.6.4.4 Impact Summary. There would be a net increase of about 15,904 pounds of trout in the overall impact area of influence, which would be a positive impact on game fish and their habitat.

This alternative would result in overall benefits to non-game fish species that co-occur with game fish, similar to the benefits for game-fish species. This would have a positive impact on non-game fish and their habitat.

Overall habitat availability and quality for other aquatic resources (i.e., amphibians and macroinvertebrates) would be improved, which would have a positive impact on other aquatic resources and their habitat.

Table 3-34
Summary of Changes in Trout Standing Crop and Biomass from Baseline Conditions Under the DRP With Pipeline Alternative

Stream / Reach	Trout Standing Crop			Trout Biomass			Percent Change from Baseline (%)
	Baseline (lb/acre)	DRP With Pipeline (lb/acre)	Change from Baseline (lb/acre)	Baseline (pounds)	DRP With Pipeline (pounds)	Change from Baseline (pounds)	
Spring Creek SP-01	64.85	64.85	-0-	84.31	84.31	-0-	-0-
Spring Creek SP-02	134.61	134.61	-0-	242.30	242.30	-0-	-0-
Spring Creek SP-03	70.23	70.23	-0-	91.30	91.30	-0-	-0-
Creamery Ditch SP-04	101.11	101.11	-0-	111.22	111.22	-0-	-0-
London Ditch SP-05	19.40	19.40	-0-	32.98	32.98	-0-	-0-
Rock Ditch RC-01	78.26	78.26	-0-	156.52	156.52	-0-	-0-
Lower Lake Creek LC-01	13.75	13.75	-0-	11.00	11.00	-0-	-0-
Daniels Creek[a] DC-05	45.37	8.52	-36.85	744.07	139.73	-604.34	-81
Daniels Creek[a] DC-06	40.71	1.78	-38.93	113.99	4.98	-109.01	-96
Upper Strawberry River[b,c]	n/a[d]	n/a	n/a	1,819	18,437	16,618	914
Totals	n/a	n/a	n/a	3,406.69	19,311.34	15,904.65	467

Notes:

[a] Reduced resident trout standing crop and biomass in Daniels Creek would be compensated by annual planting of 2,500 pounds of catchable rainbow trout to maintain a put-and-take fishery at baseline levels.

[b] Upper Strawberry River includes the Strawberry River and its tributaries above Strawberry Reservoir.

[c] Increased trout biomass in the upper Strawberry River basin as a result of terminating the DIC diversion is mitigation for impacts of the Strawberry Aqueduct and Collection System and is made possible by the DRP With Pipeline Alternative.

[d] n/a = not applicable

There would be no change from baseline conditions in water quality parameters that affect aquatic resources in Heber Valley streams. Minor changes in the hydrology of the Provo River between Jordanelle and Deer Creek reservoirs would not cause significant impacts on water-quality-related aquatic resources habitat conditions.

3.5.6.5 Daniel Replacement Project With Canal Alternative

The DRP With Canal Alternative would have the same impacts on aquatic resources as for the DRP With Pipeline Alternative (see Section 3.5.6.4).

3.5.6.6 No Action Alternative

The No Action Alternative would have no impacts on aquatic resources because no changes would occur in stream flows and habitat. The baseline conditions described in Section 3.5.5 would continue under the No Action Alternative.

3.6 Wildlife Resources

3.6.1 Introduction

The wildlife resources analysis addresses potential impacts on wildlife species and their habitat from the construction, operation and maintenance of the Proposed Action and alternatives. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.2.5. The following wildlife resources impact topics are addressed in the impact analysis:

- Game species (i.e., deer, fur-bearing mammals, waterfowl, upland game birds) and their habitat
- Non-game species (i.e., non-domestic small mammals, birds, reptiles, amphibians) and their habitat

Potential impacts on listed and candidate threatened or endangered wildlife species are described in Section 3.7, Threatened, Endangered and Candidate Species and are not considered under wildlife resources.

3.6.2 Issues Eliminated From Further Analysis

None of the wildlife resources issues raised during scoping and defined in Section 3.6.3 have been eliminated from further analysis.

3.6.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What are the potential impacts of project facilities on wildlife and their habitat?
- What are the potential impacts of providing supplemental instream flows on wildlife habitat?
- What are the effects of eliminating the transbasin diversion on wildlife habitat in upper Daniels Canyon?

3.6.4 Description of Impact Area of Influence

The wildlife resources impact area of influence for the Proposed Action and alternatives includes the zone of riparian and upland vegetation associated with the following areas:

- Heber Valley streams or reaches selected to receive target supplemental instream flows (Creamery Ditch, London Ditch, lower Lake Creek, Rock Ditch and Spring Creek)
- Daniels Creek reaches in upper Daniels Canyon that would lose flow as a result of eliminating transbasin diversions
- The upper Strawberry River and its tributaries upstream of Strawberry Reservoir that would gain flow as a result of eliminating transbasin diversions.

3.6.5 Affected Environment (Baseline Conditions)

This section defines the wildlife resources environment that would be affected by the Proposed

Action and alternatives. The affected environment of wildlife resources is the same as baseline conditions. The focus of this section is on the habitat of wildlife species, the places they occupy within the impact area of influence that may be affected by the Proposed Action and alternatives. These habitats include vegetated areas along streams and ditches (referred to as riparian zones), upland wooded areas and areas of sagebrush.

3.6.5.1 Game Species and Their Habitats

3.6.5.1.1 Mammals. Game species within the impact area of influence include mammals, waterfowl and upland game birds. The following subsections describe game species and their habitats within Heber Valley, upper Daniels Creek and the upper Strawberry River basin.

Mule deer are found in the upland woodland habitats adjacent to the Timpanogos Canal. They are not typically found along Heber Valley streams because of the lack of riparian vegetation that would provide cover. Mule deer also are found in upper Daniels Canyon on the upland slopes and within the riparian woodland vegetation along Daniels Creek. Other mammal game species, including moose, bear, elk and mountain lion, would be unlikely in Heber Valley because of the valley's developed nature and lack of suitable cover. Bear, elk and mountain lion may occasionally frequent or pass through areas of upper Daniels Canyon.

Game species of mammals that would likely be present in the upper Strawberry River basin include mule deer, elk, moose, bear, mountain lion and smaller, fur-bearing game animals. Habitats include riparian woodlands along streams in the basin and upland woodlands.

3.6.5.1.2 Birds. Game birds include waterfowl and upland game species. Waterfowl, which are seasonal and permanent residents of the Provo River corridor, frequent riparian woodlands and marshes and ponds in the non-riparian woodlands habitat category, using them for nesting, cover and feeding. Waterfowl also are seasonally present in the upper Strawberry Reservoir.

Upland game birds, including turkey, grouse, partridge and chukar, are found in steep, rocky upland habitats around the perimeter of the valley and similar areas of upper Daniels Canyon. Turkey, pheasant and quail are also likely to be found in Heber Valley. They also frequent the upland woodland habitats in the upper Strawberry River basin, which is important habitat for the sage grouse.

3.6.5.2 Non-Game Species and Their Habitats

3.6.5.2.1 Mammals. Non-game mammals, including fur-bearing species such as mink and bobcat, are probably not common in the Heber Valley because of its developed nature and lack of cover. However, they are found in areas of upper Daniels Canyon and the upper Strawberry River basin. Foxes, coyotes and raccoons are found in upper Daniels Canyon, the upper Strawberry River basin, and are relatively common in Heber Valley because they tolerate human activity. While riparian woodland is the primary habitat type used by these fur-bearing mammals, foxes and coyotes also frequent open, non-riparian woodland areas.

Other mammals that frequent the impact area of influence year-round include shrews, voles, mice, bats, rabbits, squirrels, skunk and porcupine. All use the riparian woodlands and upland woodlands for cover and foraging, and many also frequent wet areas associated with non-riparian woodlands.

3.6.5.2.2 Birds. Non-game birds that frequent the impact area of influence include raptors, wading birds, gulls, woodpeckers, owls, flycatchers, swallows and passerine (perching) species. Passerines, piciformes (flickers, woodpeckers) and other small birds use the riparian habitat associated with the river on a year-round and seasonal basis.

3.6.5.2.3 Reptiles and Amphibians. Lizards and snakes are found in upland habitats and edge areas of riparian and non-riparian woodlands in the Provo River corridor. Frogs and toads frequent grasslands, brushy areas, marshes and ponds in these woodland habitat types, while salamanders are typically found in ponds, marshes, streams and other wet areas of the riparian woodland habitat.

3.6.6 Impact Analysis

3.6.6.1 Significance Criteria

Riparian woodlands provide high-quality natural habitat, are biologically diverse, and possess specific ecological attributes that make them important in wildlife management. Wildlife species use riparian woodlands for their high palatability of forage, high productivity, shade, thermal cover during winter, and proximity to other habitat components. They also are frequently used as migration corridors because they offer cover, food and water for moving between summer and winter ranges. The importance of riparian woodlands to wildlife is also one of the key considerations of wetlands functions and values. Since wetlands are important in both a regulatory and biological sense, any permanent impacts on riparian habitat types were considered significant. Native, upland woodland vegetation in the impact area of influence is an abundant habitat type.

The following potential impacts of the Proposed Action and alternatives on game and non-game wildlife and wildlife habitat are considered significant:

- Activities resulting in permanent removal of any existing riparian woodland habitat
- Activities resulting in permanent removal of any important game-species habitat (e.g., deer fawning areas and migratory routes)
- Activities resulting in removal or disturbance of mule deer fawning areas during June and July (the fawning period) when it could lead to lowered fawning success and potential loss of deer
- Activities resulting in permanent removal of habitat for non-game species

3.6.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential wildlife resources impacts have been eliminated from further analysis.

3.6.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following subsections define potential wildlife resources impacts during the construction and operation phases of the Proposed Action.

3.6.6.3.1 Impacts During Construction. Construction of the Proposed Action would cause the following types of impacts on wildlife resources:

- Disturb and displace resident and non-resident game and non-game species as a result of noise generated by construction machinery and construction worker activities during the pipeline and canal construction period
- Remove upland woodland and sagebrush grassland habitat used by game and non-game species for the period of time required for revegetated areas to grow to a size and height that provides wildlife habitat for foraging, cover, resting and breeding

3.6.6.3.1.1 Game Species and Their Habitat. Construction activities would temporarily disturb and displace resident and non-resident mule deer and reduce their use of habitats adjacent to construction areas along the Timpanogos Canal and the pipeline construction corridor. Some mule deer potentially could be killed by construction vehicles, but this would be minimized by strict enforcement of speed limits. Since no mule deer fawning occurs in the construction activity area, there would be no significant impact on this type of critical game species habitat.

Construction of the Proposed Action would remove 15.4 acres of upland woodland and sagebrush habitat along the upslope side of the Timpanogos Canal. Revegetation of disturbed areas as part of the Proposed Action would replace 15.0 acres of this habitat. A 5- to 10-year period would be required for re-growth of the vegetation to a size and height comparable to baseline conditions. However, wildlife would be able to utilize this habitat during the period of regrowth. Sagebrush habitat totaling 0.4 acres would be removed by construction of a regulating pond at the end of the improved portion of the Timpanogos Canal and beginning of the Daniel Replacement Pipeline (see Map A-1 in pocket at back of EIS) and would not be replaced. Wildlife use of surrounding widespread sagebrush habitat would not be affected by construction of the regulating pond. No significant impacts on game species are expected to occur from construction of the Proposed Action because there would be no permanent removal of any critical game species habitat.

Game species in upper Daniels Canyon and upper Strawberry River basin habitats would not be impacted by construction activities since no construction would take place in upper Daniels Canyon and construction in the upper Strawberry River basin includes decommissioning roads, removing diversion structures, and other activities related to eliminating the transbasin diversion. These impacts would not be significant since there would be no permanent removal of any critical game-species habitat. Game species could be temporarily disturbed and displaced at construction sites in the upper Strawberry River basin. Since no critical game species habitat would be disturbed or removed there would be no significant impacts on game species.

3.6.6.3.1.2 Non-Game Species and Their Habitat. Construction activities under the Proposed Action would have the same general types of impacts on non-game wildlife species as described in Section 3.6.6.3.1.1 for game species. There would be no significant impacts on non-game wildlife species because there would be no permanent removal of any important non-game species habitat types.

3.6.6.3.2 Impacts During Operation. Operation of the Proposed Action would cause the following types of impacts on wildlife resources, which are discussed in the following sections:

- Potential loss of wildlife habitat through indirect impacts on wetlands as a result of lowered groundwater levels following conversion to sprinkler irrigation
- Potential improvements in riparian vegetation and wildlife habitat along Heber Valley streams receiving year-round supplemental instream flows
- No change from baseline conditions in riparian vegetation and wildlife habitat in upper Daniels Creek as a result of eliminating the transbasin diversion
- Potential improvements in riparian vegetation and wildlife habitat in the upper Strawberry River basin as a result of the elimination of the transbasin diversion
- Potential loss of birds from electrocution on Proposed Action power lines

3.6.6.3.2.1 Game Species and Their Habitats. Approximately 22.8 acres of wetlands wildlife habitat would potentially be impacted by operation of the Proposed Action. This includes the following areas:

- 20.7 acres of moist meadow habitats in Heber Valley that would be converted to upland as a result of lowered groundwater levels after converting to sprinkler irrigation
- 2.1 acres of riparian woodland habitat along canals that would be abandoned in the upper Strawberry River basin and converted to upland by loss of water after eliminating the transbasin diversion

These potential impacts on wetland wildlife habitat would not be significant because of benefits from restoration and enhancement of wetlands under the Proposed Action. Overall, the quantity of wetland wildlife habitat enhanced under the Proposed Action would be higher than the habitat potentially impacted during operation.

Approximately 6.0 acres of riparian (shrub) wetlands would be created, and 33.6 acres of riparian (shrub) wetlands enhanced in the upper Strawberry River basin under the Proposed Action. A summary of wetland creation and enhancement is discussed in Section 3.4.6.3.6 of this EIS. Approximately 2 to 3 growing seasons would be required for non-riparian wetland vegetation to recover to pre-construction conditions. Overall, the Proposed Action would result in a net increase of 53.6 acres in riparian and non-riparian wetlands compared to baseline conditions in the impact area of influence. There would be no significant impacts on game species and their habitat because none of the wetland habitat types would be permanently removed.

Once the revegetated areas are established, distribution and activity levels of game species would be similar to conditions prior to construction in Heber Valley. Wildlife would benefit from potential improvements in riparian vegetation cover in Heber Valley streams that receive year-round target supplemental instream flows. However, land use practices would not change, and there would be no specific management activities directed at improving the riparian zone. Riparian vegetation would improve even with continued livestock grazing because of the presence of perennial flows which would support trees and large shrubs. Also, some rotational grazing is practiced in Heber Valley and not all riparian areas would be continually grazed. Riparian vegetation in upper Daniels Canyon is not expected to change from baseline conditions because existing springs and seeps are expected to be adequate to maintain the flow of water needed to support this vegetation. There would be no significant impacts since wildlife activity levels and distribution would probably be unchanged from baseline conditions.

Potential improvements in riparian vegetation in the upper Strawberry River basin from eliminating the transbasin diversion could improve wildlife habitat. Elimination of the transbasin diversion would return natural flows to the streams in the upper Strawberry River basin and result in higher flows throughout the summer, possibly improving growth and survival of riparian vegetation. To the extent that this occurs, wildlife habitat would improve through increased cover. The overall impact on riparian vegetation and wildlife habitat would be positive.

3.6.6.3.2.2 Non-Game Species and Their Habitats. Operation of the Proposed Action would have the same general types of impacts on non-game wildlife species as described in Section 3.6.6.3.2.1 for game species. There would be no significant impacts on non-game wildlife species because no habitat types of important non-game species would be permanently removed. Potential improvements in the riparian zone vegetation in the upper Strawberry River basin would also benefit non-game wildlife habitat. Some birds may be lost from electrocution if they strike or try and perch on the power lines installed under the Proposed Action.

3.6.6.3.3 Impact Summary. Game and non-game species would be temporarily disturbed by noise and human activity during construction, possibly displacing them from the immediate construction area. Upland woodland, sagebrush and grassland, and non-riparian wetland vegetation would be temporarily disturbed during construction activities. Revegetated areas would provide wildlife habitat once they are re-established (two growing seasons for wetland vegetation and 5 to 10 years for upland woodlands). Eliminating the transbasin diversion would have a positive impact on riparian wildlife habitat in the upper Strawberry River basin.

3.6.6.4 Daniel Replacement Project With Pipeline Alternative

The following subsections define potential wildlife resources impacts during the construction and operation phases of the DRP With Pipeline Alternative.

3.6.6.4.1 Impacts During Construction. Construction of the DRP With Pipeline Alternative would result in habitat loss for wildlife resources as a result of removal of non-riparian wetland habitat used by game and non-game. The impact would occur during the time required for revegetated areas to grow to a size and height that provides wildlife habitat for foraging, cover, resting and breeding.

3.6.6.4.1.1 Game Species and Their Habitat. Construction of the DRP With Pipeline Alternative would not disturb or displace wildlife in Heber Valley because the pipeline alignment primarily crosses agricultural lands. No important habitat for game species would be removed under this alternative. Game species and their habitat would not be significantly impacted because there would be no permanent removal of any critical game species habitat.

Construction of this alternative would temporarily disturb about 6.9 acres of wetland habitat adjacent to the old Highway 40 road alignment below Jordanelle Dam and on the east side of Highway 40, just north of Heber City. Wetland types that would be impacted would include wet and moist meadows, emergent marsh and shrub wetlands. However, these wetlands would be restored after construction under the SOPs for the Proposed Action. There would be no significant impacts on game species because none of this habitat type would be permanently removed.

Since no supplemental instream flows would be provided to Heber Valley streams, there would be no changes from baseline conditions in the amount or extent of riparian zone vegetation and use by wildlife.

Impacts on game species in upper Daniels Creek and the upper Strawberry River basin would be the same as described in Section 3.6.7.3.1.1 for the Proposed Action.

3.6.6.4.1.2 Non-Game Species and Their Habitats. Construction of the DRP With Pipeline Alternative would result in removal of wetland habitat as described for game species in Section 3.6.6.4.1.1. This would result in some lost use of this habitat until restored areas were re-established. There would be no significant impacts on non-game wildlife species because the habitat would not be permanently removed.

3.6.6.4.2 Impacts During Operation. Operation of the DRP With Pipeline Alternative would cause the following types of impacts on wildlife resources:

- No change from baseline conditions for game and non-game wildlife distribution and activity levels in Heber Valley following revegetation and re-growth of disturbed areas
- No change from baseline conditions in riparian vegetation and wildlife habitat in upper Daniels Creek as a result of eliminating the transbasin diversion
- Potential improvements in riparian vegetation and wildlife habitat in the upper Strawberry River basin as a result of eliminating the transbasin diversion

3.6.6.4.2.1 Game Species and Their Habitats. Once the revegetated areas are established, distribution and activity levels of game species would be similar to conditions before construction in Heber Valley because the amount of wildlife habitat would be the same as under baseline conditions. Riparian vegetation in upper Daniels Canyon is not expected to change from baseline conditions because existing springs and seeps are expected to adequately maintain the flow of water needed to support this vegetation. Wildlife activity levels and distribution would probably be unchanged from baseline conditions.

Potential improvements in wildlife habitat in the upper Strawberry River basin under this alternative would be the same as described for the Proposed Action in Section 3.6.6.3.2.1. There would be a net increase of 74.3 acres of improved habitat for wildlife in the impact area of influence.

3.6.6.4.2.2 Non-Game Species and Their Habitats. Operation of the DRP With Pipeline Alternative would have the same general types of impacts on non-game wildlife species as described in Section 3.6.6.3.2.1 for game species. There would be no significant impacts on non-game wildlife species because no habitat types of important non-game species would be permanently removed. Potential improvements in the riparian zone vegetation in the upper Strawberry River basin would benefit non-game wildlife habitat.

3.6.6.4.3 Impact Summary. Construction and operation of this alternative would remove non-riparian wetland habitat used by game and non-game species during the time required for revegetated areas to grow to a size and height that provides wildlife habitat for foraging, cover, resting and breeding. Once these areas are re-grown, activity levels for game and non-game wildlife would resume to levels comparable to baseline conditions in Heber Valley.

There would be no change from baseline conditions in riparian vegetation and wildlife habitat in upper Daniels Creek from eliminating the transbasin diversion because there is adequate water supply from springs and seeps to maintain existing riparian vegetation.

Eliminating the transbasin diversion would potentially improve riparian vegetation and wildlife habitat in the upper Strawberry River basin. This alternative would create or enhance about 74.3 acres of wildlife habitat.

3.6.6.5 Daniel Replacement Project With Canal Alternative

The following subsections define potential wildlife resources impacts during the construction and operation phases of the DRP With Canal Alternative.

3.6.6.5.1 Impacts During Construction. Construction of the DRP With Canal Alternative would cause the following types of impacts on wildlife resources:

- Disturb and displace resident and non-resident game and non-game species from noise generated by construction machinery and workers
- Habitat loss from the removal of upland woodland and sagebrush grassland habitat used by game and non-game species. The impact would occur during the time required for revegetated areas to grow to a size and height that provides wildlife habitat for foraging, cover, resting and breeding.

3.6.6.5.1.1 Game Species and Their Habitat. Construction activities would temporarily disturb and displace resident and non-resident mule deer and reduce their use of habitats adjacent to the canal construction corridor. Some mule deer potentially could be killed by construction vehicles, but this would be minimized by strict enforcement of speed limits. Since no mule deer fawning occurs in the construction activity area, there would be no significant impact on this type of critical game species habitat.

Construction of this alternative would temporarily remove 27.6 acres of upland woodland and sagebrush habitat. Revegetation of disturbed areas as part of the DRP With Canal Alternative would result in replacement of all this habitat over a 5- to 10-year period required for re-growth to a size and height comparable to baseline conditions. Construction of the DRP With Canal Alternative would not significantly impact game species because there would be no permanent removal of any critical game species habitat.

Game species in upper Daniels Canyon and upper Strawberry River basin habitats would not be impacted by construction activities for the same reasons described in Section 3.6.6.4.1.2 for the DRP With Pipeline Alternative.

3.6.6.5.1.2 Non-Game Species and Their Habitats. Construction of this alternative would have the same impacts on non-game species as described in Section 3.6.6.5.1.1 for game species. No non-game wildlife habitat would be permanently removed by construction of this alternative, therefore no significant impacts would occur.

3.6.6.5.2 Impacts During Operation. This alternative would have the same impacts during operation as described in Section 3.6.7.4.2 for the DRP With Pipeline Alternative.

3.6.6.5.3 Impact Summary. Impacts summarized in Section 3.6.6.4.3 for the DRP With Pipeline Alternative would be the same for this alternative.

3.6.6.6 No Action Alternative

The wildlife resources impacts caused by the Proposed Action and alternatives would not occur under the No Action Alternative. The baseline wildlife conditions described in Section 3.6.5 would continue if the Proposed Action and alternatives are not implemented.

3.7 Threatened, Endangered, and Candidate Species

3.7.1 Introduction

The information and analysis documented in this section was summarized from the Draft Threatened, Endangered and Candidate Species Technical Report (CUWCD 1996b), which is available from CUWCD upon request. The threatened, endangered, and candidate (T&E) species analysis addresses potential impacts on T&E species from the construction, operation, and maintenance of the Proposed Action and alternatives. The focus of the analysis is on all T&E species potentially occurring in the impact area of influence that could be impacted. Impacts include direct, indirect, temporary and long-term effects.

A threatened, endangered or candidate status is assigned to individual species by the U.S. Fish and Wildlife Service (FWS). Species that are in danger of extinction in all or a significant portion of their range are designated as endangered. If a species is not currently in danger of extinction, but is likely to be in the foreseeable future, the species is assigned a threatened status. Candidate species are those for which a listing is possibly warranted pending further review. Listed species are provided protection under the Endangered Species Act (ESA) of 1973 (PL 93-205, as amended) against federally authorized or funded actions that may jeopardize their continued existence. In compliance with Section 7(C) of the ESA, a Biological Assessment was submitted to the FWS to disclose effects of the Proposed Action on T&E species.

The following species were included in the T&E species analysis: peregrine falcon, June sucker, bald eagle, Ute ladies'-tresses, spotted frog, whooping crane, Utah valvata snail, Colorado squawfish, bonytail chub, humpback chub and razorback sucker.

The methods used to assess impacts on T&E species are provided in Appendix B, Section B.2.6.2. For each species, the following impact topics were analyzed:

- The taking of a species (see Appendix B, Section B.2.6.2 for a definition of "take")
- Loss or degradation of habitat
- Increased stress, displacement, or reduced reproductive success

3.7.2 Issues Eliminated from Further Consideration

The FWS, in several letters, has identified specific concerns related to potential project impacts on T&E species. However, most of the species identified by the FWS as potentially occurring in the impact area of influence were eliminated from further consideration because Category-2 (C-2) species have been removed from FWS protection, and there is low potential for occurrence in the impact area of influence. FWS issued a directive in July 1995 that eliminated all C-2 species from the list, including the following: northern goshawk, ferruginous hawk, western snowy plover, loggerhead shrike, white-faced ibis, black tern, western least bittern, spotted bat, North American lynx, Utah hydroporus diving beetle, leatherside chub,

Bonneville cutthroat trout, flannelmouth sucker, roundtail chub, Utah physa and thickshell pondsnail. The determination of low potential for occurrence was based on a preliminary analysis indicating lack of habitat, or presence of unsuitable conditions (i.e., high levels of disturbance). Species eliminated because of a low potential for occurrence included the whooping crane, Utah valvata snail, Colorado squawfish, bonytail chub, humpback chub and razorback sucker.

Another related issue that was eliminated from further consideration is: How would spotted frog egg masses be impacted by extreme fluctuations in spring water levels at the U.S. Bureau of Reclamation (USBR) wetland mitigation site? The issue was dismissed because the Proposed Action and alternatives would not influence water levels in the USBR wetland.

3.7.3 Issues Addressed in the Impact Analysis

In compliance with the ESA, the FWS provided the CUWCD with a list of T&E species that potentially occur in the impact area of influence (see Appendix C). The list contains federally designated plant, fish and wildlife species. Species of particular concern to the FWS and Utah Division of Wildlife Resources are the June sucker, spotted frog, leatherside chub and Ute ladies'-tresses, all known to be present in the impact area of influence. Because leatherside chub is listed as a C-2 species and was eliminated from further consideration it is addressed instead in the Aquatic Resources section (Section 3.5 of this chapter).

Other related issues and concerns that were raised during scoping and addressed in the impact analysis include:

- What impacts would the conversion from flood to sprinkler irrigation in Heber Valley have on spotted frogs that depend on irrigation water for habitat?
- What impacts would occur to bald eagles and their habitat from providing supplemental instream flows in Heber Valley streams?
- What impacts would occur to other T&E species and their habitat from providing supplemental instream flows in Heber Valley streams?

3.7.4 Description of Impact Area of Influence

The impact area of influence consists of the following areas (see Map 3-1 in Section 3.1.1.1):

- Heber Valley, including the area between the Jordanelle Dam and Deer Creek Reservoir bounded on the east by the Timpanogos Canal and on the west by Snake Creek and River Ditch
- Upper Daniels Canyon, including the reach of upper Daniels Creek from the headwaters downstream to the upper Daniel Diversion
- Upper Strawberry River basin tributary to Strawberry Reservoir, which primarily consists of National Forest System land managed by the Heber Ranger District of the USDA–Forest Service (USFS). The upper Strawberry River basin is bordered by Strawberry Ridge, Daniel Summit and Dock Flat Ridge on the west, and

the Center-Lake Creek summit on the north. The ridge between Co-op Creek and Strawberry Valley forms the east edge of the drainage.

- A narrow corridor of aquatic habitat in the lower Provo River that extends from Deer Creek Reservoir to Utah Lake

3.7.5 Affected Environment (Baseline Conditions)

For most T&E species, baseline conditions were considered to be the same as existing conditions. However, for June sucker, baseline conditions in the lower Provo River equaled conditions under full operation of the Jordanelle River. Table 3-35 lists T&E species known to occur in the impact area of influence (C-2 species are not included). Table 3-35 briefly describes the season of occurrence, sighting information and types and quality of habitat in the impact area of influence for each species. General life history traits, sighting information and habitat availability are presented following Table 3-35.

3.7.5.1 Peregrine Falcon

Peregrine falcons typically nest on cliffs with a combination of steep vertical surfaces to prevent predation and use ledges and cracks for scrapes and roost sites. They show a strong fidelity to nest sites (FWS 1984, Kilpatrick 1987). Nesting cliffs often

Table 3-35
Summary of T&E Species Known to Occur in the WCWEP and DRP Impact Area of Influence

Species	Season of Occurrence	Sighting Information	Habitat Type	Habitat Quality
ENDANGERED SPECIES				
Peregrine falcon (*Falco peregrinus*)	Spring and fall migration	Infrequent sightings in upper Strawberry River basin	Emergent marsh, ponds, wet meadow for foraging	Optimal foraging habitat in some areas
June sucker (*Chasmistes liorus*)	May to July	Spawning in the lower 5 miles of the Provo River	Riverine	Declining
THREATENED SPECIES				
Bald eagle (*Haliaeetus leucocephalus*)	Fall migration, winter	Known to roost near the Provo River, Lake Creek, Center Creek and Strawberry River; infrequent migrants near Strawberry Reservoir	Riparian forest	Optimal roosting habitat along Provo River, Lake Creek, Center Creek, Strawberry River and Strawberry Reservoir
Ute ladies'-tresses (*Spiranthes diluvialis*)	Year-round	Two colonies have been identified south of Jordanelle Reservoir near the Provo River	Wetland and riparian habitats	Optimal in habitat along the northern portion of Provo River in Heber Valley and along Snake Creek; marginal to poor elsewhere
C-1 CANDIDATE SPECIES				
Spotted frog (*Rana pretiosa*)	Year-round	Populations near the Provo River between the Jordanelle and Deer Creek reservoirs	Ponds, wet meadow and emergent marsh	Optimal in areas currently inhabited; marginal to poor elsewhere

are located near abundant and accessible avian prey, usually within 10 miles of a forage area. Foraging areas include forests, grasslands, marshes and open bodies of water where the peregrines' primary prey are available. Most prey consists of small to medium-sized songbirds, shorebirds and waterfowl. Winter habitat is selected on the basis of large concentrations of prey birds (Reel et al. 1989).

Nesting in the impact area of influence is unlikely. In Heber Valley, the potential for peregrine falcons to nest on slopes surrounding the impact area of influence is limited by the lack of appropriate habitat (i.e., absence of vertical cliff faces, talus and rock outcrops). Although suitable nesting cliffs are present in the upper Strawberry River basin, there is no evidence that peregrine falcons have used them for this purpose.

Two reliable sightings of peregrine falcons have been documented in the impact area of influence, both in the upper Strawberry River basin. Reasonable explanations for the sightings included stopover of migrating individuals and/or hunting forays from nest sites on the Wasatch Front. Although not reported, peregrine falcons also potentially forage in Heber Valley. Occurrences of peregrine falcon in the impact area of influence would be infrequent and for short periods of time. Foraging habitat is primarily associated with riparian areas, such as shrub wetlands, wet meadows and emergent marshes, that support high densities of waterfowl and song birds during spring and fall migration.

3.7.5.2 June Sucker

The June sucker, a native species of Utah Lake, is characterized by terminal mouth, lips and gill rakers that are adapted to feed on microscopic plankton. During spring runoff in late May and early June, adults move into the lower Provo River to spawn. Spawning typically occurs in early to mid June as spring runoff is decreasing, with the eggs hatching in 1 to 2 weeks. Adults move back into the lake shortly after spawning. Larvae also apparently drift down to the lake soon after spawning (Modde and Muirhead 1990), similar to other lake sucker species (Scoppettone and Vinyard 1991). However, habitat for young fish is scarce in the lower Provo River because of the channelized nature of the river (Holden et al. 1995) and may not be sufficient to maintain the young. The early life history of the species is poorly understood.

Adequate flows between May and July, the spring runoff period, are an important characteristic of June sucker spawning and larval habitat. Both the timing and magnitude of flows during this period are important. A relatively high peak runoff flow that coincides with the natural peak flow in the river (generally in June) followed by low but adequate flows is thought to be best for June sucker. A naturally timed spring high flow may be important to maintain temporal separation of Utah sucker and June sucker spawning runs and to cue adult June sucker to move into the river for spawning. A relatively high spring flow is important for cleaning spawning areas before June sucker spawning and for removing thick mats of algae that can reduce oxygen levels in the river. Following spawning and the high spring peak, adequate flows are needed for larval drift and/or larval development in the lower river as well as for maintaining adequate temperature and oxygen levels during late June and July. June flows in the lower Provo River between 1950 and 1989, averaging 0 or 1 cfs during 16 of the 40 years, have often not been high enough to create a spring peak. July flows, averaging 0 or 1 cfs 34 out of the 40 years, also have not been adequate to meet needs of young fish. Other important factors that are likely limited today include delta-like areas into Utah Lake that provide young suckers with food, cover and growing space. Probably the major limiting factor overall for young fish is the presence of introduced predatory fish (e.g., white bass, walleye) that use both the lower river and Utah Lake.

The June sucker may have historically used as much as 30 miles or more of the Provo River, but the species is presently restricted to the lower 5 miles of the stream because of an irrigation diversion structure (Tanner Race Diversion Dam) that blocks upstream access. During most years, another diversion (Fort Fields Diversion) restricts use to the lower 3.5 miles of the river (FWS 1995).

3.7.5.3 Bald Eagle

Bald eagles typically nest in large ponderosa pine, Douglas-fir and cottonwood trees. Fish and waterfowl are the primary prey, with rabbits and carrion utilized to a lesser extent. Foraging habitat consists of large, unobstructed open areas such as openings in river corridors or lakes. Eagles also concentrate around big-game winter range and consistent sources of carrion associated with road kills (Paige et al. 1990, DeGraff et al. 1991). Perching and roost sites (on large trees with open branches) and access to prey are important habitat characteristics for bald eagles during the winter (Paige et al. 1990). Bald eagles have yearly fidelity to the same tree for roosting and nesting. They are intolerant of human disturbance, especially during the breeding season (FWS 1986). Consequently, they normally locate perches and nest sites away from human disturbances or move them if they are disturbed.

Bald eagles are known to use the impact area of influence for wintering and as a stopover during migration. In particular, they use riparian corridors associated with the Provo River between Jordanelle and Deer Creek Reservoirs, Lake Creek, Center Creek and Strawberry River below Soldier Creek Dam for winter roosting and foraging (Cranny, 1995). They also appear near the Strawberry Reservoir during the fall migration period. In general, occurrences in the impact area of influence are limited to a few individuals, and the area does not support sizable winter concentrations.

Habitat in the impact area of influence is composed of a narrow band of riparian woodlands associated with the Provo River, Lake Creek, Center Creek, Strawberry River and Strawberry Reservoir. The water bodies support a variety of prey species, including brown trout, rainbow trout, mountain whitefish, longnose dace and mountain sucker (Bear West Consulting Team 1993).

3.7.5.4 Ute Ladies'-tresses Orchid

The Ute ladies'-tresses orchid occurs in wetland and riparian areas in three distinct geographic areas: the eastern great basin of Utah and Nevada, the Colorado River drainage of eastern Utah, and the eastern front of the Rocky Mountains from southern Wyoming to south of Denver (Stone 1993). All known populations of Ute ladies'-tresses in Utah inhabit wetland sites (FWS 1992b, UNHP 1994). Plants have most often been found in old stream channels and on recently deposited material in the floodplain of adjacent rivers (UNHP 1994). Groundwater and surface river water contribute to the wetland character of these sites. The species appears to have an affinity for dynamic river systems and other areas that have recently been affected by ground-disturbing activities, as evidenced by its location in old gravel pits and other disturbed areas. Other important environmental parameters are sufficient exposure to sunlight, adequate dispersal of seed, and presence of suitable species of fungus (Gecy 1994, Hettinger 1994).

The first colony of Ute ladies'-tresses in the Provo River drainage was identified in August of 1993 (Johnson 1993). Plants were located in the northern portion of Heber Valley in a riparian area near the Provo River. A second colony was discovered in 1994 near the original location in two small side-channels. The source of water in these wetlands is most likely groundwater during the summer, with additional floodwater input during the spring.

Small pockets of optimal habitat may occur in many types of wetland habitat in Heber Valley. Most riparian wetlands, except for monospecific (single or one species) stands of cattails or bulrushes, deeply inundated areas and highly disturbed sites, have potential to provide habitat for Ute ladies'-tresses. Areas with the highest potential for occurrence or recruitment are near the colony found in 1993. These high-potential areas include riparian wetlands along the northern portions of the Provo River and Snake Creek (the southern portions are considered to have moderate potential). Other wetlands in the valley, including all canal-side wetlands, have low potential. The North Fields area contains extensive wetland areas that could provide habitat for Ute ladies'-tresses, but the potential for occurrence or recruitment is low because of intensive summer grazing and other agricultural practices. Occurrence of the species in the upper Strawberry River basin is unlikely because of high elevation limitations.

3.7.5.5 Spotted Frog

Spotted frogs are typically found in cool, clear, spring-fed water with organic substrate, anywhere from sea level to 10,000 feet in elevation. They inhabit pooled areas containing a variety of emergent, floating and submergent vegetation, and are thought to hibernate in holes near springs or other areas where water is constantly renewed and does not freeze. They deposit their eggs in shallow water, typically within 2 meters of the shoreline. Other conditions found in egg deposition areas include substrates of organics, silt and clay, and water temperatures of 52 to 59°F. The spotted frog preys on insects and a few kinds of mollusks, crustaceans and arachnids (Dumas 1966, Morris and Tanner 1969, Spahr et al. 1991, Ross et al. 1993, Ross et al. 1994).

Spotted frogs, once common in Utah, are now extremely sporadic and limited. The largest remaining population along the Wasatch Front is in wetland areas adjacent to the Provo River in Heber Valley. Known locations of spotted frogs in the impact area of influence are concentrated south of Jordanelle Dam and north of Deer Creek Reservoir.

Most habitats where spotted frogs have been found are characterized by ponds with a variety of emergent vegetation such as cattail, sedge, watercress and muskgrass. The ponds are typically supported by springs, seeps, and backwater areas of streams such as those created by beaver activity. Wet meadows, open water ponds and emergent marshes provide suitable habitat in the impact area of influence. Presence of spotted frogs in the upper Strawberry River basin is unlikely because of past rotenone treatments and lack of historical sightings.

3.7.6 Impact Analysis

3.7.6.1 Evaluation Criteria

The evaluation criteria followed guidelines established in the ESA, and are the same for all T&E species in the impact area of influence. The following types of impacts on T&E species were considered adverse:

- Taking of T&E species
- Loss of habitat that exceeds the estimated level necessary to maintain viable populations of each species
- Actions that lead to long-term disturbance to species migration and dispersal, breeding behavior, or pollination which would threaten the viability of the population

3.7.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential impacts raised during scoping were eliminated from further analysis.

3.7.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

3.7.6.3.1 Peregrine Falcon. Habitat for peregrine falcons in the impact area of influence consists of areas that attract concentrations of prey, including wet meadow, emergent marsh and open water wetland types. There would be no direct impacts on peregrine falcons or their habitat.

Indirect impacts of groundwater elevation drawdown in Heber Valley would potentially cause a loss of 20.7 acres of wet meadow. Loss of habitat from groundwater elevation drawdown would be long-term and would occur gradually over several years as groundwater levels recede. The loss of wet meadows would be an adverse indirect impact on potential peregrine falcon foraging habitat. Habitat in the upper Strawberry River basin would not be adversely affected.

Peregrine falcon would potentially benefit from the creation and enhancement of 40.2 acres of wet meadow and emergent marsh foraging habitat in the upper Strawberry River basin resulting from the restoration of natural stream flows. This would offset the losses in habitat caused by groundwater elevation drawdown, resulting in a net increase in habitat of 19.5 acres in the upper Strawberry River basin. However, benefits would be minimal because of the infrequent and temporary occurrence of peregrine falcons in the basin.

3.7.6.3.2 June Sucker. The Proposed Action would have no impact on June sucker or its habitat in the lower Provo River. On average, May, June and July flows would be slightly augmented compared to baseline conditions. However, the average flow increase would be small and would not occur during dry years. Flows during wet years would be slightly higher than baseline conditions but would not affect the June sucker or its habitat.

3.7.6.3.3 Bald Eagle. The Proposed Action would have no direct impacts on bald eagles or their habitat.

Indirect impacts would include the loss of about 2.1 acres of riparian woodlands from the abandonment and removal of DIC diversion facilities in the upper Strawberry River basin. This potential loss of habitat would be long-term and would occur gradually over several years.

Indirect and temporary impacts would occur on bald eagle habitat during construction. Construction in Heber Valley between November and March would potentially result in temporary and indirect disturbance to roosting individuals. Bald eagles that inhabit areas in the upper Strawberry River basin would not be affected by construction work, which would be conducted from July to mid-September when they are absent from the area. Placement of the WCWEP distribution pipelines, construction of several pumping stations, and rehabilitation of the Timpanogos Canal would occur near documented roost sites near Lake and Center creeks.

In addition, rehabilitation of the Timpanogos Canal would occur near the riparian woodland in the upper portion of the Provo River corridor where bald eagles potentially roost. It is unlikely that construction of these facilities would result in a taking of individuals. However, they could cause temporary relocation of roost sites into adjacent riparian habitat. Bald eagles would likely return to these areas to roost after completion of construction, either in the same season or during the following winter.

Increased flows in several streams would indirectly have positive effects on bald eagles by increasing an important prey source. Increased stream flows would improve the overall fish habitat and increase prey populations in the Provo River, Rock Ditch, Spring Creek, Creamery Ditch, London Ditch, lower Lake Creek, the Strawberry River and its tributaries in the upper Strawberry River basin. Improvement of the aquatic resources in the impact area of influence would provide long-term benefits to bald eagles.

3.7.6.3.4 Ute Ladies'-tresses. Ute ladies'-tresses have not been documented in areas that would be directly impacted by construction of the Proposed Action. Therefore, the Proposed Action would likely not result in the known taking of a threatened species.

Projected groundwater elevation drawdown associated with the conversion of flood to sprinkler irrigation in Heber Valley would potentially cause an indirect, long-term loss of 20.7 acres of wet meadow. These indirect impacts would occur over several years as groundwater levels recede. The wetland areas are considered marginal habitat for Ute ladies'-tresses because of the dominance of sedge vegetation and their constant exposure to disturbance. Marginal habitats are not considered important to the continued survival of the species because these areas are common throughout Heber Valley.

3.7.6.3.5 Spotted Frog. Spotted frogs have not been documented in wet meadows that would be affected by the Proposed Action. Therefore, the Proposed Action would have no direct or indirect impacts on spotted frogs or their habitat.

3.7.6.3.6 Impact Summary. Potential impacts of the Proposed Action are summarized in Table 3-36.

3.7.6.4 Daniel Replacement Project With Pipeline Alternative

3.7.6.4.1 Peregrine Falcon. Pipeline construction under the DRP With Pipeline Alternative would directly impact peregrine falcon by removing 6.6 acres of wet meadow and 0.3 acre of emergent marsh habitat that is suitable for foraging. Impacts would be temporary, lasting two growing seasons until the affected area is sufficiently revegetated. Peregrine falcons would not be adversely affected by this alternative because of the temporary nature, small scale of impacts, and the low probability and frequency of occurrence of peregrine falcons in the impact area of influence. In addition, all wetland impacts would be fully restored under the SOPs in Chapter 1, Section 1.12.9. Benefits to peregrine falcon would be the same as described for the Proposed Action in Section 3.7.6.3.1. This alternative would result in a net increase of 40.2 acres of peregrine falcon foraging habitat.

3.7.6.4.2 June Sucker. Impacts on June sucker and its habitat would be similar to those described for the Proposed Action in Section 3.7.6.3.2. Flows during average, wet and dry years would change only slightly from baseline conditions.

3.7.6.4.3 Bald Eagle. Bald eagles and their habitat would not be directly affected by pipeline construction under this alternative. Minimal,

Table 3-36
Summary of T&E Species Impacts

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Alternative	Type of Potential Impact	Peregrine falcon[1]	June sucker[1]	Bald eagle[1]	Ute ladies'-tresses[1]	Spotted frog
Proposed Action (WCWEP With Daniel Replacement Pipeline)	Taking	No	No	No	No	No
	Temporary increased stress, displacement, or reduced reproductive success	No	No	Yes	No	No
	Loss or degradation of habitat *before* conservation[2]	None	None	None	None	None
	Loss or degradation of habitat *after* conservation[3]	20.7 acres	None	2.1 acres	20.7 acres	None
	Beneficial impacts	40.2 acres	None	Restored streams in Heber Valley and upper Strawberry River basin	None	None
	Net change	Gain of 19.5 acres	None	Loss of 2.1 acres, beneficial effects of restored flows	Loss of 20.7 acres of marginal habitat	None
Daniel Replacement Project With Pipeline	Taking	No	No	No	No	Yes
	Temporary increased stress, displacement, or reduced reproductive success	No	No	Yes	No	Yes
	Loss or degradation of habitat *before* conservation[2]	6.9 acres	None	None	6.9 acres	1.9 acres
	Loss or degradation of habitat *after* conservation[3]	None	None	2.1 acres	None	None
	Beneficial impacts	40.2 acres	None	Restored streams in upper Strawberry River basin	None	None
	Net change	Gain of 40.2 acres	None	Loss of 2.1 acres, beneficial effects of restored flows	None	None

Table 3-36
Summary of T&E Species Impacts

Page 2 of 2

Alternative	Type of Potential Impact	Peregrine Falcon[1]	June Sucker[1]	Bald Eagle[1]	Ute Ladies'-tresses[1]	Spotted Frog
Daniel Replacement Project With Canal	Taking	No	No	No	No	Yes
	Temporary increased stress, displacement, or reduced reproductive success	No	No	Yes	No	Yes
	Loss or degradation of habitat *before* conservation[2]	6.9 acres	None	None	6.9 acres	1.9 acres
	Loss or degradation of habitat *after* conservation[3]	None	None	2.1 acres	None	None
	Beneficial impacts	40.2 acres	None	Restored streams in upper Strawberry River basin	None	None
	Net change	Gain of 40.2 acres	None	Loss of 2.1 acres, beneficial effects of restored flows	None	None

Notes:

[1] Impacts would be minimal and would not be considered to affect viability of the populations

[2] Impacts on habitat would be direct and temporary until conservation is fully implemented. All habitat loss would be offset by wetland standard operating procedures

[3] Impacts would be indirect and long-term, occurring after the Proposed Action or alternatives are fully implemented

indirect effects of the loss of 2.1 acres of roosting habitat and disturbance to roosting individuals would be similar to those described for the Proposed Action in Section 3.7.6.3.3. Improved fish populations in the upper Strawberry River basin would indirectly have positive effects on bald eagles by increasing an important prey source.

3.7.6.4.4 Ute Ladies'-tresses. Ute ladies'-tresses would be directly impacted by the temporary removal of 6.6 acres of wet meadow, 0.3 acre of emergent marsh, and less than 0.1 acre of shrub wetland during pipeline construction. Impacts would last two growing seasons, until the affected area is sufficiently revegetated. Effects of habitat losswould be minimal for reasons described in Section 3.7.6.3.4.

3.7.6.4.5 Spotted Frog. Pipeline construction under the DRP With Pipeline Alternative would directly impact spotted frogs by temporarily removing 1.6 acres of wet meadow and 0.3 acre of emergent marsh habitat that is known to be occupied (see Map 3-8). Habitat would be restored within two growing seasons. Other direct impacts include the potential crushing of individual frogs by maneuvering equipment in occupied areas during construction.

Indirect impacts would result from the temporary removal of surrounding vegetation and disturbance to soils in and adjacent to occupied spotted frog habitat during construction. The impacts would potentially consist of drying or freezing of egg masses and tadpoles because of changes in water levels; changes in water quality, temperature, and/or sediment levels resulting in a loss in viability of individuals; changes in vegetation composition and decreased availability of food sources and protective areas; and disturbances of breeding adults, resulting in reduced reproductive success or displacement. Indirect impacts would last two growing seasons, until disturbed areas are sufficiently restored (see Section 3.19.5).

The level and type of impact on spotted frogs would depend on the timing of construction. Impacts on the various life stages would generally occur on the following time-frame:

- Adult spotted frogs are present year-round. Construction between mid-March and late April would disrupt breeding individuals. Between mid-October and mid-March, adults typically hibernate in the same areas and would not be able to escape from construction equipment.

- Egg masses are present between mid-March and mid-May.

- Tadpoles emerge beginning in early April and may not complete metamorphosis until mid-October. However, the majority of tadpoles appear to complete the transformation by late August.

The current viability of the Heber Valley population already is in question because of low population numbers, fragmentation of habitat and varying spring water conditions. All temporarily disturbed habitat would be replaced as part of wetland restoration under the SOPs in Section 1.12.9 of Chapter 1. Other conservation measures would be necessary to minimize and/or avoid mortality and reduced reproductive success (see Section 3.19.4).

3.7.6.4.6 Impact Summary. Potential impacts of the DRP With Pipeline Alternative are summarized in Table 3-36.

3.7.6.5 Daniel Replacement Project With Canal Alternative

3.7.6.5.1 Peregrine Falcon. The DRP With Canal Alternative would have the same impacts on peregrine falcons as described in Section 3.7.6.4.1.

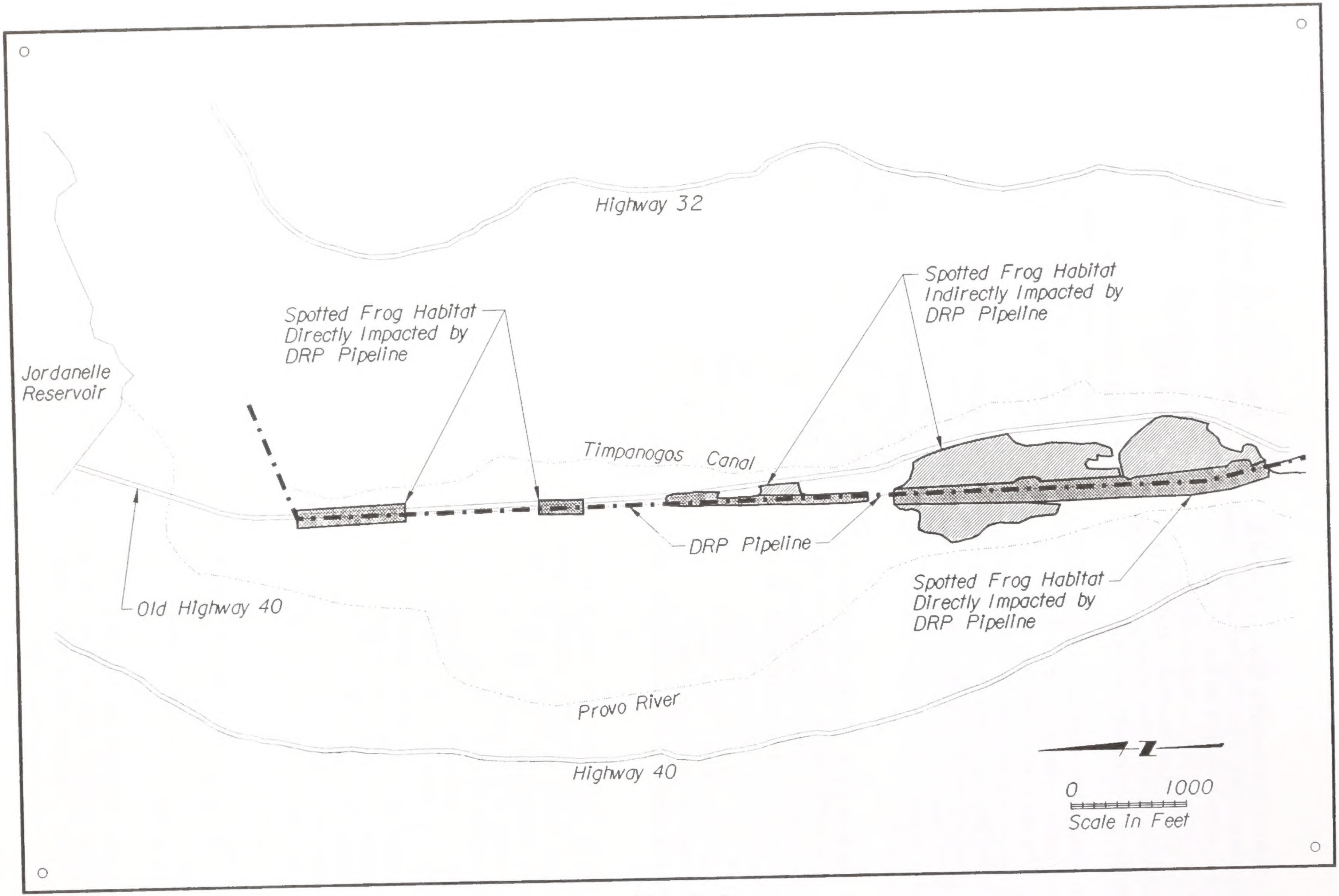
3.7.6.5.2 June Sucker. Impacts on June sucker and its habitat would be similar to that discussed in Section 3.7.6.4.2. Flows during average, wet and dry years would not change from baseline conditions.

3.7.6.5.3 Bald Eagle. This alternative would have the same impacts on bald eagles as described in Section 3.7.6.4.3.

3.7.6.5.4 Ute Ladies'-tresses. This alternative would have the same impacts on Ute ladies'-tresses as described in Section 3.7.6.4.4.

3.7.6.5.5 Spotted Frog. This alternative would have the same impacts on spotted frogs as described in Section 3.7.6.4.5.

3.7.6.5.6 Impact Summary. Potential impacts of the DRP With Canal Alternative are summarized in Table 3-36.


Highway 32
Spotted Frog Habitat Directly Impacted by DRP Pipeline
Spotted Frog Habitat Indirectly Impacted by DRP Pipeline
Jordanelle Reservoir
Timpanogos Canal
DRP Pipeline
Spotted Frog Habitat Directly Impacted by DRP Pipeline
Old Highway 40
Provo River
Highway 40
N
0
1000
Scale In Feet

Map 3–8
Areas of Potential Impact on Spotted Frog Under the
DRP With Pipeline and the DRP With Canal Alternatives

3.7.6.6 No Action Alternative

The No Action Alternative would have no impact on T&E species and their habitat. Baseline conditions would continue as described in Section 3.7.5.

3.8 Soil Resources

3.8.1 Introduction

The soil resources analysis addresses potential impacts on soil resources from the construction, operation and maintenance of the Proposed Action and alternatives. The focus of the analysis is on soil resource quality, which is based on a complex set of interactive factors, including physical and chemical properties, irrigation water quality, irrigation system type and management, crop and soil management, and drainage conditions. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.2.7.

The following soil resources impact topics are addressed in the impact analysis:

- Soil erosion and stability
- Soil quality

3.8.2 Issues Eliminated From Further Analysis

None of the soil-related issues identified during scoping have been eliminated from further analysis.

3.8.3 Issues Addressed in the Impact Analysis

The following issues were raised in scoping and are addressed in the soil impact analysis:

- How would the Proposed Action affect the erodibility of soils in areas converted to sprinkler irrigation?
- What soil impacts would occur from sediment production and erosion along streams receiving supplemental in-stream flows?
- How would soil productivity change under the Proposed Action and alternatives?
- How would the stability of soil masses be affected by the Daniel Replacement pipeline?
- Would the construction of pipelines or enlargement of the Timpanogos Canal increase erosion?
- What soil impacts would occur from trenching and backfill operations across existing agricultural fields during pipeline construction?

3.8.4 Description of Impact Area of Influence

The soil impact area of influence consists of Heber Valley lands that would be converted from flood to sprinkler irrigation as an indirect result of the Proposed Action; lands affected by construction of the Proposed Action and alternatives; land along the streams that would receive supplemental flows under the Proposed Action; and land in the upper Strawberry River basin affected by abandonment and removal of the DIC diversion facilities.

3.8.5 Affected Environment (Baseline Conditions)

This section defines the soil resources environment that would be affected by the Proposed Action and alternatives. The affected environment of the soil resources is the same as baseline conditions.

Soils in Heber Valley can be separated into three general groups or associations as described by the NRCS (SCS 1976). The first group is the Yeates Hollow, Watkins Ridge and Deer Creek association, which consists of well-drained, deep soils formed in alluvium (soil material deposited by streams) and residuum (soil material formed in place) from mixed sedimentary rocks on foothills, mountain foot slopes and alluvial fans. The Wasatch and Timpanogos Canals generally traverse these soils. The second group is the Holmes and Rasband association, which consists of well-drained and somewhat poorly drained, deep soils formed in mixed alluvium on alluvial fans and stream terraces. These soils occur above the Heber Valley bottomlands and are primarily found in the vicinity of Center Creek and Lake Creek. The third general group is the Kovich, Fluventic Haploborolls and Crooked Creek association, which consists of moderately well-drained and poorly drained, deep soils formed in mixed alluvium on floodplains, low stream terraces and valley bottoms. These soils occur primarily on Heber Valley bottomlands in the vicinity of Daniels Creek, Snake Creek and the Provo River.

A number of factors combine to make erosion from runoff negligible in the Heber Valley impact area of influence under baseline conditions. Native vegetation on unirrigated lands acts to retard water movement across the soil surface and promote infiltration of water from precipitation and snowmelt. Maintenance of vegetation, along with irrigation and crop management practices on irrigated croplands, also minimizes runoff. Both sprinkler and flood irrigation systems are managed under baseline conditions to minimize runoff and return flows to surface waters.

Significant erosion occurs at two headcuts in the upper Strawberry River basin impact area of influence. The Bjorkman and McGuire headcuts discharge a significant amount of soil (annual average of 177 cubic yards at Bjorkman and 266 at McGuire) into the streams in Bjorkman Hollow, below the McGuire tunnel and into the upper Strawberry River and Daniels Creek. These headcuts also are the source of sedimentation and related water quality and aquatic resource problems.

Soils in the impact area of influence do not have high salinity concentrations, and the growth and yield of crops are not affected by salinity concentrations. The baseline salinity is less than 4.0 millimhos per centimeter (mmhos/cm) (SCS 1976). A millimho is a unit of electrical conductance.

3.8.6 Impact Analysis

3.8.6.1 Significance Criteria

Potential soil erosion and stability impacts were considered significant if they would prevent successful soil restoration and recovery to near pre-construction conditions within five years. The significance of potential erosion impacts on water quality is addressed in Section 3.3, Water Quality. The potential impacts on soil resource quality are defined in this section. The related significance criteria are discussed in Section 3.11 where they are used by the agriculture discipline to help determine the significance of impacts on soil productivity.

3.8.6.2 Potential Impacts Eliminated From Further Analysis

Potential impacts on soil quality from pipeline trenching and canal modifications were eliminated from further analysis because the SOPs include replacement of existing topsoil during trench backfilling and along the outer edge of modified canals.

3.8.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

3.8.6.3.1 Soil Erosion and Stability Related to Construction. The potential for significant erosion impacts from construction activities would be avoided or minimized by the type of procedures used to construct the Proposed Action, the relatively level terrain of the construction areas, and the erosion control SOPs described in Section 1.12.9 of Chapter 1. Proposed Action facilities have generally been sited to use existing canal and roadway alignments, minimizing the need to trench across existing agricultural fields. In some cases, Proposed Action pipelines would cross existing canals and creeks.

Since the banks and beds of the canals are disturbed by cleaning each year under baseline conditions, the enlargement and rehabilitation measures and trenching associated with the Proposed Action would not cause much additional disturbance compared to baseline conditions. Enlargement and rehabilitation would consist of cleaning the canals and, in some cases, constructing a concrete lining on the downslope side. This work would take place within existing canals without major earthwork since the canal cross-section is sufficient to convey required flows. In areas where trenching is required, a temporary and negative impact to soil resources would occur. However, the SOPs would restore these areas to near their original condition because all topsoil would be removed, stockpiled and replaced after construction and revegetation procedures. SOPs that would be used during and immediately after construction are designed to stabilize the soil surface and restore vegetation to avoid erosion and sedimentation problems. Erosion that does occur in areas affected by construction would return to near baseline conditions soon after the soil stabilization and revegetation SOPs have been completed.

The Proposed Action would cause positive soil impacts in the upper Strawberry River basin as the DIC diversion facilities are abandoned and removed. Stabilization of the Bjorkman and McGuire headcuts would significantly decrease the erosion and sedimentation that is occurring under baseline conditions (177 and 266 cubic yards per year, respectively). Positive impacts also would occur in Heber Valley as the long-term stability of soil masses along canals are improved with construction of concrete lining and as downslope seepage losses are significantly reduced.

Replacement of existing unlined canal reaches with buried pipelines also would have a positive impact on soils in Heber Valley, helping stabilize existing soil masses by essentially eliminating seepage from the canals.

3.8.6.3.2 Soil Erosion and Stability Related to Increased Streamflows. The Proposed Action would add supplemental flows to five Heber Valley streams. London Ditch, Creamery Ditch, Rock Ditch and Spring Creek have year-round flows under baseline conditions, and lower Lake Creek is usually dry about 10 months of the year. The potential sources of erosion along these streams are the livestock that graze and walk along and in them and peak runoff flows. This situation would not change under the Proposed Action. The volume and velocity of supplemental instream flows under the Proposed Action would be relatively low compared to peak runoff flows, when velocity is the highest and most of the erosion along these streams occurs. Therefore, the supplemental instream flows would gradually cause minor increases in erosion of the streambanks over a relatively long period of time.

The Proposed Action also would increase flows in some streams of the upper Strawberry River basin, which would cause gradual and long-term erosion of the streambed in the restored streams, as is typical under natural conditions.

3.8.6.3.3 Soil Erosion and Stability Related to Reduced Flows in Daniels Creek. The Proposed Action would reduce flows in upper Daniels Creek once the transbasin diversion is terminated. This would reduce erosion of the streambank and streambed along the affected reach of Daniels Creek.

3.8.6.3.4 Soil Quality. Conversion from flood to sprinkler irrigation is not expected to change the chemical characteristics of soil in the affected areas. Based on the 1976 SCS Soil Survey, soil salinity is low (less than 4.0 mmhos/cm). Even though more efficient irrigation would result in less water moving through the soil profile, leaching percentages (the percentage of irrigation water applied in excess of demand to maintain soil salinity at a predetermined level) are expected to exceed 20 percent under the Proposed Action. This is sufficient to maintain baseline soil salinity levels because adequate amounts of irrigation water would continue to percolate below the crop root zone, thereby removing excess salts from the soil profile.

Changes in irrigation practices, facilitated by the Proposed Action, are expected to have a positive impact on soil productivity as irrigation efficiencies are improved and fertilizer use becomes more efficient. Conversion to sprinkler irrigation would help maintain more favorable soil moisture content and reduce fertilizer losses to deep percolation, promoting crop growth and improving yields. The Proposed Action is not expected to change the physical characteristics of soil in agricultural areas since the conversion from flood to sprinkler irrigation systems would not affect soil erosion from agricultural runoff (SCS 1994).

3.8.6.3.5 Impact Summary. Supplemental flows in Heber Valley streams and restored flows in the upper Strawberry River basin would cause a minor and gradual increase in streambank and streambed erosion. The reduction in Daniels Creek flows would cause a minor and gradual decrease in streambank and streambed erosion along Daniels Creek. The rehabilitation of the DIC irrigation facilities would eliminate major soil erosion and sedimentation problems in the upper Strawberry River basin. The SOPs would avoid adverse increases in soil erosion and sedimentation during construction.

3.8.6.4 Daniel Replacement Project With Pipeline Alternative

3.8.6.4.1 Soil Erosion and Stability. As described in Section 3.8.6.3.1, adverse soil erosion and stability impacts during and immediately after construction would be avoided and minimized as a result of the types of construction procedures used, the relatively level terrain and the erosion control SOPs (see Chapter 1, Section 1.12.9). No significant impacts are expected.

In the upper Strawberry River basin, the DRP With Pipeline Alternative would cause a major reduction in erosion and sedimentation in the streams below the Bjorkman and McGuire headcuts. A minor and gradual increase in the erosion of streambanks and streambeds would occur in streams that are restored. The reduction in Daniels Creek flows would cause a decrease in streambank and streambed erosion along Daniels Creek.

3.8.6.4.2 Impact Summary. There would be a minor and gradual increase in erosion along the Strawberry River and streams that would have restored flows. A major reduction in erosion would occur in the upper Strawberry River basin streams below the Bjorkman and McGuire headcuts.

3.8.6.5 Daniel Replacement Project With Canal Alternative

3.8.6.5.1 Soil Erosion and Stability. The enlargement of the Timpanogos Canal under this alternative would have the potential to cause erosion and sedimentation during and immediately after construction. However, as described in Section 3.8.6.3.1, the types of construction procedures used and the erosion control SOPs (see Chapter 1, Section 1.12.9) would minimize or avoid adverse soil erosion and stability and significant impacts are not expected.

In the upper Strawberry River basin, the DRP With Canal Alternative would cause a major reduction in erosion and sedimentation in the streams downstream of the Bjorkman and McGuire headcuts. A minor and gradual increase in the erosion of streambanks and streambeds would occur in streams that are restored. The reduction in Daniels Creek flows would cause a decrease in streambank and streambed erosion along Daniels Creek.

3.8.6.5.2 Soil Quality. This alternative would not change soil quality since it does not include changes in irrigation methods and the SOPs include the replacement of existing topsoil during trench backfilling.

3.8.6.5.3 Impact Summary. The impact summary in Section 3.8.6.4.3 also applies to the DRP With Canal Alternative.

3.8.6.6 No Action Alternative

The No Action Alternative would lead to a continuation of baseline soil conditions, and the positive and negative soil impacts summarized above would not occur. Existing erosion and sedimentation problems associated with the Bjorkman and McGuire headcuts would continue.

3.9 Mineral and Energy Resources

3.9.1 Introduction

This analysis addresses potential impacts on mineral and energy resources from the construction, operation and maintenance of the Proposed Action and alternatives. Assumptions and impact topic analysis methods are summarized in Appendix B, B.2.8.

The following topics are addressed in the impact analysis:

- Existing and planned mineral resource sites
- Energy consumed during project construction and operation
- Impacts on energy generation and transmission sources

3.9.2 Issues Eliminated From Further Analysis

All of the mineral and energy resource issues identified during scoping were addressed in the impact analysis.

3.9.3 Issues Addressed in the Impact Analysis

The following issues were addressed in the impact analysis:

- Would Heber Valley mineral resources be affected by the Proposed Action and alternatives?

- What changes in energy consumption would occur during construction, operation and maintenance of the Proposed Action and alternatives?

3.9.4 Description of Impact Area of Influence

The impact area of influence for the mineral and energy resources analysis consists of existing and planned mineral resource sites in Heber Valley; construction sites in Heber Valley; pumping stations and other facilities where energy would be used in Heber Valley; and, to a lesser extent, power generation and transmission facilities affected by the Proposed Action and alternatives.

3.9.5 Affected Environment (Baseline Conditions)

This section defines the mineral and energy resources that would be affected by the Proposed Action and alternatives. The affected mineral and energy resources are the baseline conditions, which is the same as existing conditions.

The following mineral resource sites are located in Heber Valley: two existing gravel mining operations in the Daniel Creek vicinity; an existing sandstone quarry in the Lake Creek vicinity; an existing private quarry near Jordanelle Dam; and a potential gravel mining operation in the Lake Creek vicinity. The gravel needed for borrow material during construction of the Proposed Action and alternatives would be obtained from one of the quarries near Daniels Creek.

The roads where energy would be used for construction, operation and maintenance activities and the roads where workers would commute to and from construction sites are identified in Section 3.18, Transportation. Roads where additional energy would be used by fishermen and other recreationists for access to the streams to be enhanced by the Proposed Action are also identified in Section 3.18.

3.9.6 Impact Analysis

3.9.6.1 Significance Criteria

Impacts on mineral resources are considered significant if 1) extraction of mineral resources would be precluded or obstructed, or 2) existing supplies at mineral resource sites would not be sufficient to supply the project and new sites would have to be developed.

Energy resource impacts are considered significant if the use of energy associated with the Proposed Action and alternatives would be wasteful, i.e., if it exceeds the amount of energy typically used by projects of this type or feasible energy conservation measures are not successfully implemented.

Energy resource impacts are considered significant if the energy needs of the Proposed Action and alternatives cannot be supplied by existing generation or transmission capacity, or if modification of existing power lines would affect the quality of service to users of existing lines.

3.9.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential mineral and energy resource impacts have been eliminated from further analysis.

3.9.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

3.9.6.3.1 Mineral Resources. As defined in Table 1-20 and Section 1.12.5 of Chapter 1, the Proposed Action would require 56,700 cubic yards of off-site gravel borrow material, which would be extracted from an existing site. A single site near Deer Creek Reservoir and Daniels Creek has sufficient capacity to supply all borrow material needed by the Proposed Action. The construction and recreation traffic generated by the Proposed Action would not preclude or obstruct the extraction of minerals from any existing or planned mineral resource sites in Heber Valley. Based on the mineral resource significance criteria, the related impacts of the Proposed Action would not be significant.

The 3 miles of pipe to be installed in the Strawberry River basin would be laid in an existing ditch and covered with local material. Therefore, no impacts would occur on mineral resources from installation of the pipe.

3.9.6.3.2 Energy Used During Construction and Operation. A total of 151,600 gallons of fuel would be used during construction of the Proposed Action (excluding abandonment and removal of DIC diversion facilities in the upper Strawberry River basin). Of this total, 124,000 gallons of fuel would be used by construction vehicles and 27,600 gallons would be used by workers commuting to construction sites. Operation and maintenance traffic would use 6,100 gallons of fuel per year. About 3 million kilowatt hours per year (kwh/yr) would be used by the pumping station under the Proposed Action. Some existing pumps would no longer be needed, which would save 1.1 million kwh/yr. The net increase in energy usage caused by the Proposed Action would be 1,890,000 kwh/yr. The total energy that would be used during operation and maintenance of the Proposed Action (assumed to be 100 years) would be about 300 million kwh.

Additional energy would be used during abandonment and removal of DIC diversion facilities as construction equipment is used and construction workers travel to the upper Strawberry River basin.

Fishermen and other recreationists would be attracted to the restored streams in the upper Strawberry River basin and Heber Valley streams that receive target supplemental instream flows. This would increase the use of energy in the impact area of influence as recreation-related traffic increases.

Under the Proposed Action, groundwater levels would be lower than those under baseline conditions, which would require an average increase in pumping lift of 30 feet and increased energy consumption for well-pumping (see Section 3.2.6.3.6.3 for a description of well impacts caused by the Proposed Action). The greater pumping lift under the Proposed Action would require an additional 16,000 kwh/yr to produce the same amount of groundwater (approximately 350 acre-feet) in the impacted area.

According to project engineers, the energy use described is typical of these types of projects. These impacts would not be significant based on the energy significance criteria.

3.9.6.3.3 Energy Generation and Transmission Sources. The power sources and requirements of the Proposed Action are defined in Section 1.12.6 of Chapter 1. The Colorado River Storage Project (CRSP) and the associated transmission lines (HL&P) that would be used to operate the Proposed Action have sufficient existing capacity to supply the Proposed Action during construction and operation. Furthermore, the energy required by the project's pumping stations would be a small percentage of the energy generated at the CRSP power plants and transmitted by the transmission lines to the Heber valley. However, several two-phase lines must be upgraded to serve the pumping stations with three-phase power. Table 1-11 in Section 1.8.4.1 of Chapter 1, lists the power line extension and upgrade footage for each pumping station. The project would not significantly affect energy generation sources based on the energy significance criteria, but several transmission lines would be upgraded. Service to power users would not be interrupted as the power lines are upgraded and extended.

3.9.6.3.4 Impact Summary. A net increase of 1,890,000 kwh/yr would be needed to operate the Proposed Action, plus about 16,000 kwh/yr additional for groundwater pumping. About 152,000 gallons of fuel would be used during construction, and 6,100 gallons per year would be used for operation and maintenance. Energy transmission impacts would include power line extensions and modifications to include three-phase lines. None of these impacts would be significant based on the criteria described in Section 3.9.6.1.

3.9.6.4 Daniel Replacement Project With Pipeline Alternative

3.9.6.4.1 Mineral Resources. This alternative would cause the same types of mineral impacts as described for the Proposed Action in section 3.9.6.3.1. The DRP With Pipeline Alternative would require 33,300 cubic yards of off-site borrow material. The related impacts of this alternative would not be significant based on the mineral resource significance criteria.

The 3 miles of pipe that would be installed in the upper Strawberry River basin would be laid in an existing ditch and covered with local material. Therefore, there would be no impacts on mineral resources from installation of the pipe.

3.9.6.4.2 Energy Used During Construction and Operation. A total of 42,500 gallons of fuel would be used during construction of this alternative, excluding abandonment and removal of DIC diversion facilities in the upper Strawberry River basin. Of that total, 28,700 gallons would be used by construction vehicles and 13,800 gallons would be used by workers commuting to construction sites. Operation and maintenance traffic would use 300 gallons of fuel per year, and 832,000 kwh/yr would be used at the project's pumping stations. This energy would be new consumption. Therefore, the total energy that would be used during the project's operation and maintenance period (assumed to be 100 years) would be 83.2 million kwh.

Additional energy would be used for construction equipment and by construction workers traveling to the upper Strawberry River basin during abandonment and removal of DIC diversion facilities.

The energy use described above is typical of these types of projects. These impacts would not be significant based on the energy significance criteria.

3.9.6.4.3 Energy Generation and Transmission Sources. The power sources and requirements of this alternative are the same as described for the Proposed Action in Section 3.9.6.3.3. The project would not significantly affect energy generation sources based on the energy significance criteria, but some transmission lines would be upgraded and extended. Service to power users would not be interrupted as the power lines are upgraded and extended.

3.9.6.4.4 Impact Summary. Additional energy would be needed to operate this alternative, including a net increase of 832,000 kwh/yr during operation, 42,500 gallons of fuel during construction, and about 300 gallons per year for operation and maintenance. Energy transmission impacts would occur in the form of power line extensions and modifications to include three-phase lines. None of these impacts is significant based on the criteria described in Section 3.9.6.1.

3.9.6.5 Daniel Replacement Project With Canal Alternative

3.9.6.5.1 Mineral Resources. This alternative would cause the same types of mineral impacts as described for the Proposed Action in section 3.9.6.3.1. The DRP With Canal Alternative would require 13,300 cubic yards of off-site borrow material. Related impacts of this alternative would not be significant based on the mineral resource significance criteria.

The 3 miles of pipe to be installed in the upper Strawberry River basin would be laid in an existing ditch and covered with local material. Therefore, there would be no impacts on mineral resources from installation of the pipe.

3.9.6.5.2 Energy Used During Construction and Operation. A total of 33,500 gallons of fuel would be used during construction of this alternative, excluding abandonment and removal of DIC diversion facilities in the upper Strawberry River basin. Of this total, 17,300 gallons would be used by construction vehicles and 16,200 gallons by workers commuting to construction sites. Operation and maintenance traffic would use 800 gallons of fuel per year, and the project's pumping stations would use 802,000 kwh/yr. This energy would be new consumption due to this project alternative. The total amount of energy that would be used during the project's operation and maintenance period (assumed to be 100 years) would therefore be 80.2 million kwh.

Additional energy would be used for construction equipment and by construction workers traveling to the upper Strawberry River basin during abandonment and removal of DIC diversion facilities.

The energy use described above is typical of these types of projects. These impacts would not be significant based on the energy significance criteria.

3.9.6.5.3 Energy Generation and Transmission Sources. The power sources and requirements of this alternative are the same as described for the Proposed Action in Section 3.9.6.3.3. The project would not significantly affect energy generation sources based on the energy significance criteria, but some transmission lines would be upgraded. Service to power users would not be interrupted as the power lines are upgraded and extended.

3.9.6.5.4 Impact Summary. Additional energy would be needed to operate this alternative, including a net increase of 802,000 kwh/yr during operation, 33,500 gallons of fuel during construction, and about 800 gallons per year for operation and maintenance. Energy transmission impacts will occur in the form of power line extensions and modifications to include three-phase lines. None of these impacts would be significant based on the criteria described in Section 3.9.6.1.

3.9.6.6 No Action Alternative

The gravel borrow material needed to construct the Proposed Action and alternatives would not be extracted under the No Action Alternative. Baseline conditions for mineral and energy resources would continue as described in Section 3.9.5.

3.10 Air Quality

3.10.1 Introduction

The air quality analysis addresses potential impacts on air quality from the construction, operation and maintenance of the Proposed Action and alternatives. The assumptions and impact topic analysis methods used to conduct the air quality analysis are described in Appendix B, Section B.2.9. The following topics are included in the impact analysis:

- Vehicles emissions during construction
- Emissions from recreation traffic
- Dust emitted from construction procedures
- Dust emitted from changes in agricultural practices

3.10.2 Issues Eliminated From Further Analysis

All of the air quality issues raised during scoping and listed in Section 3.10.3 were assessed in the impact analysis.

3.10.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the air quality impact analysis:

- What effects would the Proposed Action and alternatives have on air quality during construction?
- What effects would changes in recreational use of Heber Valley streams have on air quality?
- Would the conversion to sprinkler irrigation change agricultural practices and cause related air quality impacts?

3.10.4 Description of Impact Area of Influence

The air quality impact area of influence includes areas where the Proposed Action and alternatives would be constructed and the roads used by construction or recreation traffic. The Proposed Action and alternatives would be constructed on the eastern side of Heber Valley and in the upper Strawberry River basin. The primary roads used by construction traffic would be Highway 40 in Heber Valley and Daniels Creek canyon, and Highway 189.

3.10.5 Affected Environment (Baseline Conditions)

Although air quality data have not been collected in Heber Valley, the valley's air quality usually is excellent. This has led to the designation of Heber Valley as a Class II attainment area, subjecting it to National Prevention of Significant Deterioration of Air Quality standards. These standards are designed to prevent deterioration of air quality in attainment areas (areas where the federal government has chosen to prevent degradation of excellent air quality). The primary types of emissions in Heber Valley under baseline conditions are nitrogen oxides (NO_x), sulfur oxides (SO_x) particulate matter (measured as PM_{10} or particles less than 10 microns in diameter) from vehicles, smoke from fireplaces, wood stoves and agricultural burning; and dust from the tilling of agricultural fields. These emissions are considered pollutants and are by-products of combustion except for dust caused by wind erosion of soil. Inversion layers occasionally trap these pollutants in the valley when certain climatic conditions exist, usually in the winter.

3.10.6 Impact Analysis

3.10.6.1 Significance Criteria

The Utah Air Conservation Rules (UACRs) identify Wasatch County as a Class II attainment area. The impact area of influence is thus subject to National Prevention of Significant Deterioration of Air Quality standards. The State of Utah has set limits on the maximum allowable increase in pollutant concentrations, which vary by the class (I, II, or III) of the attainment area designation. Class I attainment areas are generally national parks, monuments, wilderness, wild and scenic rivers and other similar areas where protection of air quality is a high priority. Class II attainment areas allow greater concentrations of pollutants than Class I attainment areas, but still have scenic features that required protection of air quality. Class II attainment areas allow the greatest increase in concentrations of pollutants. The air quality significance criteria are based on the limits on the maximum allowable increase as defined by the UACRs.

Air quality impacts of the Proposed Action and alternatives would be significant if the applicable air quality standards would be violated. The Proposed Action and alternatives would violate the standards if they emit more than 250 tons of NO_x, SO_x or particulates in any 12-month period of construction. Particulates include dust emissions and pollutants emitted from the burning of fuel, especially diesel fuel burned by large trucks and other vehicles. These standards only apply to direct air quality impacts of projects, which include emissions from construction traffic and operation of construction equipment. Indirect impacts would include emissions from traffic induced by new recreation opportunity.

3.10.6.2 Potential Impacts Eliminated From Further Analysis

All of the air quality issues raised during scoping were assessed in the impact analysis, except air quality impacts related to changes in agricultural practices. The Agricultural Resources analysis in Section 3.11 concluded the irrigation conversions associated with the Proposed Action would not cause changes in cropping patterns and, therefore, dust-emitting agricultural practices.

3.10.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

3.10.6.3.1 Vehicle Emissions During Construction. Construction of the Proposed Action would increase emissions at construction sites and along roads that would be used by construction vehicles and equipment. Highways 40 and 189 would be the primary roads used by construction traffic. Table 3-37 shows the maximum annual emissions that would occur during any 12-month period of construction. These estimates are based on worst-case assumptions; actual emissions would likely be lower because construction equipment is rarely operated throughout the day. None of these impacts are expected to be significant because the related air quality regulations would not be violated. The emissions during construction, even under worst-case assumptions, would be well below the 250-ton threshold.

The construction vehicles used to help build the HCSS would cause a minor increase in vehicle emissions in Heber City.

3.10.6.3.2 Emissions From Recreation Traffic. As described in Section 3.16, the Proposed Action would increase recreation use in the upper Strawberry River basin, indirectly causing changes in recreation-related traffic and associated emissions. Traffic and vehicle emissions in the Strawberry and Heber valleys and Daniels Canyon would increase since many fishermen traveling to the restored streams in the upper Strawberry River basin would drive through Heber Valley from the Provo/Orem and Salt Lake City regions and up Daniels Canyon on Highway 40. The air quality standards defined in Section 3.10.6.1 would not be violated because they only apply to the direct air quality impacts of a project.

Table 3-37
Maximum Vehicle Emissions During Any 12-Month Period of Construction
(tons)

	Nitrogen Oxides (NO_x)	Sulfur Oxides (SO_x)	Particulates (PM_{10})
Proposed Action (WCWEP With Daniel Replacement Pipeline)	150	13	11
DRP With Pipeline Alternative	50	4	3
DRP With Canal Alternative	57	5	4

3.10.6.3.3 Dust Emitted From Construction Procedures. Some dust would be released and become airborne during construction of the Proposed Action. Most airborne dust would likely be caused by the stabilization of two headcuts in the upper Strawberry River basin, construction vehicles traveling over dirt roads, and modifications to Heber Valley canals. However, the SOPs defined in Section 1.12.9 of Chapter 1 include periodic watering of equipment, borrow and spoil material, and roads, which would prevent large amounts of dust from being emitted.

3.10.6.3.4 Impact Summary. Construction vehicles and practices would increase vehicle and dust emissions in Heber and Strawberry valleys during construction of the Proposed Action. However, these air quality impacts would be significant. A net increase in recreation traffic would increase emissions in the upper Strawberry River basin and Heber Valley over the long-term.

3.10.6.4 Daniel Replacement Project With Pipeline Alternative

3.10.6.4.1 Vehicle Emissions During Construction. Vehicles used to construct the DRP With Pipeline Alternative would emit NO_x, SO_x and particulates. The maximum emissions that would occur during any 12-month period of construction are defined in Table 3-37. These estimates are a worst-case scenario. In fact, actual emissions would likely be lower because construction equipment is rarely operated throughout the day. The emissions would not be significant because they would be well under the emissions threshold of 250 tons in a 12-month period.

3.10.6.4.2 Emissions From Recreation Traffic. The impacts summarized for the Proposed Action in Section 3.10.6.3.2 would occur under the DRP With Pipeline Alternative.

3.10.6.4.3 Dust Emitted From Construction Procedures. Most dust emissions would likely be caused by the stabilization of two headcuts in the upper Strawberry River basin and construction vehicles traveling over dirt roads during construction of the DRP With Pipeline Alternative. However, the SOPs defined in Section 1.12.9 of Chapter 1 include periodic watering of equipment, borrow and spoil material, and roads, which would prevent large amounts of dust from being emitted.

3.10.6.4.4 Impact Summary. The construction vehicles and practices used during construction of this alternative would increase emissions in the Heber and Strawberry valleys. A net increase in recreation traffic would increase emissions in the upper Strawberry River basin and Heber Valley over the long-term. None of these air quality impacts are expected to be significant because the applicable air quality regulations would not be violated.

3.10.6.5 Daniel Replacement Project With Canal Alternative

3.10.6.5.1 Vehicle Emissions During Construction. The vehicles used to construct the DRP With Canal Alternative would emit NO_x, SO_x and particulates. The maximum emissions that would occur during any 12-month period of construction are defined in Table 3-37. These estimates are a worst-case scenario. In fact, actual emissions would likely be lower because construction equipment is rarely operated nonstop throughout the day. These impacts would not be significant because the applicable standards would not be violated.

3.10.6.5.2 Emissions From Recreation Traffic. The impacts described for the Proposed Action in Section 3.10.6.3.2 would occur under the DRP With Canal Alternative.

3.10.6.5.3 Dust Emitted From Construction Procedures. The description of dust emissions associated with the Proposed Action in Section 3.10.6.3.3 also applies to the DRP With Canal Alternative.

3.10.6.5.4 Impact Summary. Construction vehicles and practices associated with this alternative would increase emissions in Heber and Strawberry valleys. A net increase in recreation traffic would increase emissions in the upper Strawberry River basin and Heber Valley over the long-term. However, none of these air quality impacts are expected to be significant because the related air quality standards would not be violated.

3.10.6.6 No Action Alternative

The air quality impacts of the Proposed Action and alternatives would not occur under the No Action Alternative. Baseline air quality conditions would continue as described in Section 3.10.5.

3.11 Agricultural Resources

3.11.1 Introduction

The agricultural resources analysis addresses potential impacts on agricultural resources from the construction, operation and maintenance of the Proposed Action and alternatives. The analysis focuses on agricultural production impacts caused by the Proposed Action and alternatives. Potential economic impacts related to these topics are described in the Socioeconomics section (Section 3.12) of this chapter. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.2.10. The following impact topics are addressed in the agricultural resources impact analysis:

- Livestock grazing and production
- Livestock watering and production
- Cropland and crop production
- Agricultural practices and operations

3.11.2 Issues Eliminated From Further Analysis

The following issues were raised in scoping but have been eliminated from further consideration.

- What effects would occur from reclassifying similar 6W land (land not suited for irrigation) to make it eligible for supplemental water?

  This issue was eliminated because the reclassification of 6W land is not part of the Proposed Action and alternatives.

- What impacts would occur on farmers and ranchers if livestock are excluded from areas along streams?

  This issue was eliminated because livestock will not be excluded from areas along streams under the Proposed Action and alternatives.

3.11.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- How would supplemental instream flows affect present agricultural practices along the streams?
- How would fields that continue to receive flood irrigation water be impacted by pipelines buried in the fields?

- What impacts would the WCWEP have on cropping patterns and other agricultural practices in Heber Valley?

- What effects would the WCWEP distribution pipelines installed through fields have on agricultural operations?

- What effects would the Proposed Action and alternatives have on agricultural production during construction?

- What impacts would occur to agricultural production as more people move into Heber Valley, and how could this change the demand for water under the Proposed Action and alternatives?

- What impacts would occur to livestock watering during spring and fall with the Proposed Action and alternatives?

- What impacts would occur to livestock in Daniels Canyon without the transbasin water from the Strawberry River basin?

3.11.4 Description of Impact Area of Influence

The impact area of influence primarily consists of agricultural lands in Heber Valley that would be converted from flood to sprinkler irrigation and affected by potential construction of new facilities and their rights-of-way. The impact area of influence also includes the upper Strawberry River basin and upper Daniels Creek where livestock rely on the stream as a drinking water source.

3.11.5 Affected Environment (Baseline Conditions)

This section defines the agricultural resources that would be affected by the Proposed Action and alternatives. Baseline conditions for agriculture are not the same as existing conditions. As explained further in this section, baseline includes those conditions that will be in place once supplemental CUP water is delivered to Heber Valley's irrigation companies.

The Heber Valley agricultural industry includes production of crops that in turn support the livestock enterprises that are the main source of agricultural income in the valley. The primary livestock enterprises are beef cattle, sheep production and dairy operations. The total irrigated area in Heber Valley encompasses about 12,800 acres, with 7,823 acres affected by the Proposed Action. The major crops grown under irrigation in Heber Valley are alfalfa, small grain (barley and oats), grass pasture and grass hay. The surrounding uplands and some lands in Heber Valley are used for grazing, but are not irrigated. Agricultural lands along the Provo River corridor are used for grazing and irrigated pasture and grass hay. Crop yields are affected by water supply availability and reliability and method of irrigation. Sprinkler-irrigated lands typically have higher crop yields than those that are flood-irrigated.

Agricultural lands affected by the Proposed Action and alternatives would undergo a production change after converting from flood to sprinkler irrigation or from changes in water supply availability. This area would consist of 3,675 flood-irrigated and 4,148 sprinkler-irrigated acres under baseline conditions. Water supply availability could change on all 7,823 acres, while a change in productivity would occur on the 3,675 acres that would be converted from flood to sprinkler irrigation. This conversion would be made possible by the Proposed Action. Map 1-2 in Section 1.8.1 of Chapter 1 shows the location of land that would be converted to sprinkler irrigation.

Existing cropping patterns in the impact area of influence would change under baseline conditions when supplemental CUP irrigation water is available (once Jordanelle Reservoir begins full operation) and water supplies become more available and reliable. The availability of supplemental CUP water under baseline conditions would drive a cropping pattern change from the predominant pasture to alfalfa as farmers take advantage of the better water supply. Thus, most of the cropping pattern changes would occur under baseline conditions, while additional changes under the Proposed Action and alternatives would be minor.

Table 3-38 summarizes crop acreage, average crop yield and productivity under baseline conditions. The cropping pattern under baseline conditions is expected to be about 71 percent alfalfa (approximately 5,583 of the 7,823 acres affected by

Table 3-38
Summary of Crop Acreage, Average Yield and Productivity Under WCWEP and DRP Baseline Conditions

Crop	Units/Acre	Total Acreage		Average Yield/Acre		Total Production
		Sprinkler	Flood	Sprinkler	Flood	
Pasture	AUMs*	669	779	8.1	5.7	9,859
Alfalfa	Tons	3,027	2,556	4.3	3.5	21,962
Barley	Bushels	452	340	100	100	79,200

Note:
*AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

the Proposed Action); 19 percent permanent pasture (about 1,448 of the 7,823 acres affected by the Proposed Action); and 10 percent small grains (about 792 of the 7,823 acres affected by the Proposed Action). Crop yields under baseline conditions also would improve as water availability and reliability improves with the delivery of supplemental CUP water.

3.11.6 Impact Analysis

3.11.6.1 Significance Criteria

Since the significance of impacts on livestock and crop production is based on how such impacts would affect agricultural operations and economics, the significance of potential production impacts are defined and addressed in the Agricultural Practices and Operation section (Section 3.11.6.3.4) and Socioeconomics section of this chapter (Section 3.12).

Potential impacts on agricultural practices and operations are considered significant and adverse if the Proposed Action and alternatives would cause a long-term and substantial alteration to such practices as fertilizer and pesticide applications, cultivation practices, the location and operation of irrigation facilities and other production methods on grazing lands and croplands.

3.11.6.2 Potential Impacts Eliminated From Further Analysis

The following potential impacts on agricultural resources were eliminated from further analysis because they are not expected to occur under the Proposed Action and alternatives:

- What impacts would occur on agricultural production as more people move into Heber Valley, and how could this change the demand for water under the Proposed Action and alternatives?

  The Proposed Action and alternatives would not cause more people to move into Heber Valley (see the growth-inducing discussion in Section 3.12.7.3.9) The demand for irrigation water in Heber Valley is related to the types of crops grown and the amount of agricultural acreage. An increase in the valley's population, from causes other than the Proposed Action and alternatives, could change the overall demand for water. However, on a per acre basis, the total amount of water used by municipal and industrial uses approximates the total used by agriculture.

3.11.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

Table 3-39 summarizes crop acreage, average crop yield and total production under the Proposed Action and alternatives.

3.11.6.3.1 Livestock Grazing and Production. The impacts of construction on livestock grazing and production would include lands permanently removed from grazing and production. Other lands would be temporarily removed from grazing and production for temporary construction access. Table 3-40 summarizes the acreage and related loss of production from grazing land and cropland caused by temporary disturbance during construction. These lands would be restored to their original use after completion of construction.

Table 3-41 summarizes the acreage and related loss of production from grazing land and cropland permanently removed. These lands would not be restored to their original use after completion of construction.

The changes in crop production during construction of the Proposed Action and alternatives are summarized in Table 3-42.

The Proposed Action would cause a temporary disturbance of grazing lands during construction, which would reduce productivity by 51 AUMs. The temporary disturbance would cause a minor loss in production from 34.1 acres of grazing lands. The affected areas are dispersed and comprise only a small percentage of the total land used for grazing in Heber Valley. These impacts would be temporary because grazing could continue after construction on the 34.1 acres, and the nature of the impacts would have little effect on managing livestock operations.

3.11.6.3.2 Livestock Watering and Production. No impact is expected on livestock watering during and immediately after construction because SOPs would maintain livestock watering facilities

Table 3-39
Summary of Crop Acreage, Average Yield and Productivity Under the Proposed Action and Alternatives

Crop	Units/Acre	Total Acreage Sprinkler	Total Acreage Flood	Average Yield/Acre Sprinkler	Average Yield/Acre Flood	Total Production
PROPOSED ACTION (WCWEP WITH DANIEL REPLACEMENT PIPELINE)						
Pasture	AUMs*	1,448	NA	8.2	NA	11,874
Alfalfa	Tons	5,583	NA	4.3	NA	24,007
Barley	Bushels	792	NA	100	NA	79,200
DRP WITH PIPELINE ALTERNATIVE						
Pasture	AUMs	669	779	8.1	5.5	9,703
Alfalfa	Tons	3,027	2,556	4.3	3.5	21,962
Barley	Bushels	452	340	100	100	79,200
DRP WITH CANAL ALTERNATIVE						
Pasture	AUMs	669	779	8.1	5.5	9,703
Alfalfa	Tons	3,027	2,556	4.3	3.4	21,707
Barley	Bushels	452	340	100	100	79,200

Note:
*AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-40
Summary of Impacts on Grazing Land and Cropland From Temporary Disturbances During Construction of Proposed Action and Alternatives[1]

Alternatives	Irrigation Method	Grazing Land		Pasture		Alfalfa		Barley	
		Acreage	Total AUMs[2]	Acreage	Total AUMs	Acreage	Total Tons	Acreage	Total Bushels
Proposed Action (WCWEP With Daniel Replacement Pipeline	None	34.1	51						
	Flood			21.5	123	71.5	250	9.2	920
	Sprinkler			13.4	109	61.1	263	9.2	920
DRP with Pipeline	None	9.8	15						
	Flood			14.9	85	49.7	174	6.4	640
	Sprinkler			1.7	14	5.6	24	0.7	70
DRP with Canal	None	2.6	4						
	Flood			5.7	32	19.0	67	2.4	240
	Sprinkler			2.1	17	10.0	43	1.5	150

Notes:

[1] Acreage and production on lands temporarily disturbed during construction and then returned to agricultural use

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-41
Summary of Impacts on Grazing Land and Cropland From Permanent Removal Under the Proposed Action and Alternatives[1]

Alternatives	Irrigation Method	Grazing Land		Pasture		Alfalfa		Barley	
		Acreage	Total AUMs[2]	Acreage	Total AUMs	Acreage	Total Tons	Acreage	Total Bushels
Proposed Action (WCWEP With Daniel Replacement Pipeline	None	0.2	<1						
	Flood								
	Sprinkler			1.7	14	7.9	34	1.2	120
DRP with Pipeline	None	0.0	0						
	Flood								
	Sprinkler					0.3	1		
DRP with Canal	None	0.0	0						
	Flood								
	Sprinkler					3.7	16		

Notes:

[1] Crop acreage and production permanently removed from construction of project facilities

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-42
Summary of Production Impacts During Construction of the Proposed Action and Alternatives[1]

Alternative	Grazing Land Total AUMs[2]	Cropland		
		Pasture Total AUMs	Alfalfa Total Tons	Barley Total Bushels
PROPOSED ACTION (WCWEP WITH DANIEL REPLACEMENT PIPELINE)				
Baseline		9,859	21,962	79,200
Temp. Disturbance	51	231	513	1,840
Perm. Removal	<1	14	34	120
Total Decrease	-51	-245	-547	-1,960
Percent Change		-2.5	-2.5	-2.5
DRP WITH PIPELINE ALTERNATIVE				
Baseline		9,859	21,962	79,200
Temp. Disturbance	15	99	198	710
Perm. Removal	0	0	1	0
Total Decrease	-15	-99	-199	-710
Percent Change		-1.0	-0.9	-0.9
DRP WITH CANAL ALTERNATIVE				
Baseline		9,859	21,962	79,200
Temp. Disturbance	4	50	110	390
Perm. Removal	0	0	16	0
Total Decrease	-4	-50	-126	-390
Percent Change		-0.5	-0.6	-0.5

Notes:

[1] Change in crop production during construction from temporary disturbance and permanent removal of agricultural lands

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

equivalent to those under baseline conditions. Supplemental flows in Heber Valley streams would have a beneficial impact on livestock watering along these streams since flows would be available longer compared to baseline conditions. The Proposed Action would result in an average flow reduction in upper Daniels Creek of about 33 percent, based on average hydrologic conditions (see Water Resources Section 3.2.6.3.3.1). Average monthly flow under the Proposed Action would range from about 2.83 cfs in October to 27.50 cfs in June. The USFS grazing allotment for west Daniels Creek canyon is 535 cows with calves during the summer months, generally from late May or early June to late September. The lowest average flow under the Proposed Action during that period would be 6.75 cfs in August. This would equate to a daily water volume of about 4.37 million gallons, or 8,170 gallons per cow and calf, which is more than adequate for livestock watering.

The USFS grazing allotment for east Daniels Creek canyon is 935 cows with calves during the summer months, generally from late May or early June to late September. This area consists of a number of canyons that feed into Daniels Creek canyon. The area is separated from Daniels Creek by Highway 40, and livestock in east Daniels canyon do not have access to water from Daniels Creek. The Proposed Action would not affect livestock watering and production in East Daniels canyon except for McGuire canyon where abandonment of the DIC facilities would reduce flows. A spring in McGuire canyon is used for livestock watering, but the volume is not adequate to provide sufficient water. Therefore, the USFS would provide additional water to McGuire canyon under the Proposed Action and return livestock watering conditions to near baseline conditions.

No impact is expected on livestock watering and production in the upper Strawberry River basin. Abandonment and removal of DIC diversion facilities would provide alternative sources of water for livestock and wildlife that would support maintenance of baseline grazing patterns and distribution. The system improvements included in the abandonment and removal plan have been designed to handle projected grazing and watering levels. Providing adequate water to maintain baseline grazing patterns also would reduce animal congregation on riparian lands and areas with gentle slopes.

3.11.6.3.3 Cropland and Crop Production. The impacts of construction on crop production would include lands used for temporary access and lost production during the first year from lands permanently removed from production. Table 3-42 summarizes the loss of crop production during construction. The Proposed Action would result in the temporary disturbance and permanent removal of cropland during construction. The temporary disturbance would cause a minor loss of production on 185.9 acres of cropland (see Table 3-39). Soils would be restored immediately following construction, using the SOPs described in Section 1.12.9 of Chapter 1. The Proposed Action also would result in the permanent removal of 10.8 acres of cropland (see Table 3-41), which would cause a loss of production during construction (see Table 3-42).

Table 3-43 summarizes the annual changes in crop production after construction of the Proposed Action and alternatives. These changes would occur each year after construction and would be caused by: (1) production lost from land permanently removed during construction; (2) production increases on land converted to sprinkler irrigation under the Proposed Action; and (3) changes in the availability of water supplies.

Even though the Proposed Action would permanently remove some land from production, it also would facilitate a 9.2 percent increase in annual production of alfalfa and a 20.3 percent increase in pasture due to the increase in water supply quantity and reliability and conversion from flood to sprinkler irrigation. Annual barley production after construction would decrease slightly by 0.2 percent because of the permanent removal of 1.2 acres of barley from production.

3.11.6.3.4 Agricultural Practices and Operations. Agricultural practices and operations would be impacted during and immediately after construction. Changes to agricultural practices and operations from construction would be temporary and minor. The SOPs described in Section 1.12.9.1 of this EIS would help minimize and avoid adverse impacts on agricultural practices and operations. Long-term changes to irrigation facilities and operation, cultivation and fertilization practices would be minor and would occur only in the small portion of land that would be permanently removed from production.

Table 3-43
Summary of Annual Production Impacts After Construction of the Proposed Action and Alternatives[1]

Alternative	Pasture Total AUMs[2]	Cropland Alfalfa Total Tons	Barley Total Bushels
PROPOSED ACTION (WCWEP WITH DANIEL REPLACEMENT PIPELINE)			
Baseline	9,859	21,962	79,200
Proposed Action	11,860	23,973	79,080
Increase or Decrease	2,001	2,011	-120
Percent Change	20.3	9.2	-0.2
DRP WITH PIPELINE ALTERNATIVE			
Baseline	9,859	21,962	79,200
DRP/Pipeline	9,703	21,961	79,200
Increase or Decrease	-156	-1	0
Percent Change	-1.6	0.0	0.0
DRP WITH CANAL ALTERNATIVE			
Baseline	9,859	21,962	79,200
DRP/Canal	9,703	21,691	79,200
Increase or Decrease	-156	-271	0
Percent Change	-1.6	-1.2	0.0

Notes:

[1] Crop production under the Proposed Action and alternatives adjusted to reflect lost production from permanent removal of agricultural lands (Table 3-38 less Table 3-40)

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

The conversion of flood-irrigated areas to sprinkler irrigation would reduce the total amount of water applied per acre because of better irrigation efficiency and changes in water management procedures. An increase in crop yields associated with the Proposed Action would change fertilizer practices on lands converted to sprinkler irrigation because of higher crop nutrient requirements associated with increased yields. These higher fertilizer application rates are not expected to cause significant impacts because the additional nutrients would be utilized by crops to produce the higher yields. Since changes to cropping patterns would occur under baseline conditions, the Proposed Action would not change pesticide applications and other cultivation practices.

3.11.6.3.5 Impact Summary. The Proposed Action would cause temporary disturbance and permanent removal of grazing land and cropland during construction, resulting in a temporary 1-year loss of grazing and cropland production and an annual permanent loss in crop production. However, the conversion to sprinkler irrigation would increase crop production under the Proposed Action. Changes in agricultural practices would involve irrigation application and management, and fertilizer application rates. Supplemental flows in creeks would be beneficial for livestock watering

3.11.6.4 Daniel Replacement Project With Pipeline Alternative

3.11.6.4.1 Livestock Grazing and Production. This alternative would temporarily disturb grazing lands during construction, which would reduce productivity by 15 AUMs and cause a minor loss of production on 9.8 acres of grazing land (see Table 3-40 in Section 3.11.6.3.1). Similar to the Proposed Action, impacts on livestock grazing would be minor and temporary, using SOPs during and immediately after construction.

3.11.6.4.2 Livestock Watering and Production. As described for the Proposed Action in Section 3.11.6.3.2, SOPs implemented during and immediately after construction would help avoid livestock watering impacts in the impact area of influence. Daniels Creek flows would be the same as described for the Proposed Action, and no significant impacts on livestock watering in west or east Daniels Creek canyon would occur. Livestock watering and production in the upper Strawberry River basin also would be the same as described for the Proposed Action.

3.11.6.4.3 Cropland and Crop Production. This alternative would temporarily disturb some croplands and permanently remove other croplands during construction. The temporary disturbance would cause the following minor production losses on 79 acres of cropland (see Table 3-40 in Section 3.11.6.3.1). Construction would result in the permanent removal of 0.3 acres of cropland (1 ton of alfalfa production), as shown in Table 3-41.

Table 3-43 summarizes the annual change in crop production after construction of the DRP With Pipeline Alternative. This alternative would cause a minor decrease in annual production for alfalfa and pasture after construction. This decrease in annual production would result largely from a slight reduction in available irrigation water supplies.

3.11.6.4.4 Agricultural Practices and Operations. This alternative would cause the same type of impacts on agricultural practices and operations during construction as described for the Proposed Action in Section 3.11.6.3.4. This alternative is not expected to cause impacts on agricultural practices and operations after construction.

3.11.6.4.5 Impact Summary. The DRP With Pipeline Alternative would cause minor decreases in agricultural production during and after construction.

3.11.6.5 Daniel Replacement Project With Canal Alternative

3.11.6.5.1 Livestock Grazing and Production. Construction of this alternative would cause the temporary disturbance of grazing lands, which would reduce productivity by 4 AUMs on 2.6 acres of grazing land (see Table 3-40). Impacts on livestock grazing are expected to be minor and temporary.

3.11.6.5.2 Livestock Watering and Production. The impacts of this alternative on livestock watering would be the same as those described in Section 3.11.6.4.2.

3.11.6.5.3 Cropland and Crop Production. This alternative would temporarily disturb some croplands and permanently remove other croplands during construction. The temporary disturbance would cause a minor loss of production on 40.7 acres of cropland (see Table 3-40 in Section 3.11.6.3.1). The construction process would result in the permanent removal of 3.7 acres of cropland, which would be out of production during and after construction. This permanent production loss would include 16 tons (3.7 acres) of alfalfa, as shown on Table 3-40.

Table 3-43 summarizes the annual change in crop production after construction of the DRP With Canal Alternative. This alternative would cause a minor decrease in annual production for alfalfa and pasture after construction. This decrease in annual production would result largely from a slight reduction in available irrigation water supplies.

3.11.6.5.4 Agricultural Practices and Operations. Impacts on agricultural practices and operations would be the same as described in Section 3.11.6.4.4 for the DRP With Canal Alternative.

3.11.6.5.5 Impact Summary. The DRP With Canal Alternative would cause minor decreases in agricultural production during and after production.

3.11.6.6 No Action Alternative

The No Action Alternative would not cause impacts on agricultural resources. Baseline conditions described in Section 3.11.5 would continue under the No Action Alternative.

3.12 Socioeconomics

3.12.1 Introduction

The socioeconomic analysis addresses potential impacts on social and economic factors from the construction and operation of the Proposed Action and alternatives. The focus of the analysis is on potential impacts on the retail trade, construction and farm sectors of the local economy. The following impact topics are addressed in the analysis:

- Population
- Agricultural economics
- Gross revenue in other sectors
- Income
- Employment
- Public services and related fiscal conditions
- Housing
- Social conditions
- Growth-inducing conditions

3.12.2 Issues Eliminated From Further Analysis

The following issues were raised during scoping and have been eliminated from further analysis:.

- Are there opportunities to guide socioeconomic changes in Heber Valley by providing pressure irrigation water as it is needed?
  The Proposed Action and alternatives have not been designed to guide socioeconomic changes in Heber Valley. Local land-use planning agencies, rather than the CUWCD, have the authority and responsibility to guide and plan socioeconomic changes in the valley.

- What are the economic impacts on water right shareholders who have only decreed water delivered to them?

  Some Heber Valley water users have historically diverted water in excess of their water rights. This is now changing as Jordanelle Reservoir goes into operation and water users are allowed to divert only the amount specified in their water rights. The impacts of these reductions are caused by implementation and operation of the CUP and are occurring before the Proposed Action and alternatives would be implemented. Full compliance with water rights was assumed during the definition of baseline conditions and during the water resource model runs for the Proposed Action and alternatives.

3.12.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the socioeconomic impact analysis:

- What are the probable economic impacts of storage fees, pumping fees, user fees and Native American claims from water delivered to farms in the upper Daniel Irrigation Company service area?

- What are the probable economic impacts, expressed in costs per acre, to farmers and homeowners due to conversion from flood to sprinkler irrigation?

- What would be the probable economic impacts to Heber Valley farmers?

- What are the probable economic impacts associated with storage of conserved water in Jordanelle Reservoir?

- What are the probable social and economic impacts to Heber Valley due to growth inducement?

- What probable economic impacts would new recreation and resource users have on Heber Valley?
- How might the Proposed Action and alternatives affect the provision of public services?

- What are the likely social impacts from an increase in recreationists and possible trespassing on private property?

3.12.4 Description of Impact Area of Influence

The socioeconomic impact area of influence is Wasatch County, with emphasis on Heber Valley, including Heber City, Midway, Charleston and surrounding unincorporated areas. Widespread and diffuse socioeconomic impacts may occur in other areas of Wasatch County or outside the county in areas where project materials are purchased and construction workers live.

3.12.5 Affected Environment (Baseline Conditions)

3.12.5.1 Population

Wasatch County's population has grown significantly — more than 2 percent a year — since 1990. This growth has been fueled by job growth along the Wasatch Front, primarily in Salt Lake City and in the Provo/Orem area, which are within commuting distance. This transformation of Heber Valley from an area characterized by small farms to a Wasatch Front bedroom community is expected to continue. The siting of the 2002 Winter Olympics in Park City is expected to strengthen this trend. The county's population was assumed to increase at a 2.5 percent average annual growth rate, resulting in approximately 13,211 residents in Wasatch County by the year 2000 (Utah Office of Planning and Budget 1992).

3.12.5.2 Agricultural Economics

The average farm size in Heber Valley is 17 acres; 8 percent are larger than 40 acres, and 27 percent are less than 5 acres. Many farms have been converted to "hobby" farms that are not the primary source of income for their owners. A total of 7,823 acres of farmland are in the impact area of influence. Total gross revenue from all farm enterprises that would be affected by the Proposed Action and alternatives is estimated to average $1,753,000 per year under baseline conditions. The types of crops grown on these farms and baseline cropping patterns are defined in Section 3.11 of this EIS.

3.12.5.3 Gross Revenue in Other Sectors

In addition to the farm sector, the retail trade sector of the local economy would be affected by the Proposed Action and alternatives. This includes businesses that would supply construction materials, fuel and other retail services to construction workers and eventually, recreationists traveling through Wasatch County on their way to restored streams in the upper Strawberry River basin. Baseline gross retail revenue in Wasatch County is estimated to be about $70,453,000 a year. Total gross revenue in all sectors of the county's economy under baseline conditions is estimated to be $120,673,000 a year. (Total revenue and income in Wasatch County is also referred to as regional gross revenue or income).

3.12.5.4 Income

Non-farm income in Wasatch County has steadily increased since 1987, rising an average of 7.9 percent a year through 1992 (U.S. Bureau of Economic Analysis 1994). Over the same period, the county's population has increased from 8,700 in 1980 to 10,700 in 1992, an annual average of 1.7 percent (Utah Office of Planning and Budget 1994). This suggests a long-term trend of increasing per-capita income. Total income in Wasatch County increased 7.7 percent in 1992 and 6.6 percent in 1993. Baseline conditions were defined based on the assumption of a 7 percent annual increase in non-farm income. Total income in Wasatch County under baseline conditions is estimated to be $116,366,000 in the year 2000.

Baseline income projections assume continued retail trade growth fueled by a growing population and the emergence of tourism as an important industry. Through third quarter of calendar year 1995, services, construction and local government continue to fuel growth in the county. Total retail trade income under baseline conditions is estimated to be $12,168,000 in the year 2000.

Continued new home construction is causing an increase in construction income. Permit-authorized construction increased 21.3 percent in 1995 (Utah Department of Employment Security 1995b). Total construction income by place of work under baseline conditions is estimated to be $21,108,000 in the year 2000. The county's farm sector exhibited flat personal income growth during the

1980s and through 1995. Current projections indicate the farm sector will remain flat throughout the impact period (Utah Department of Employment Security 1995b). Total farm income by place of work under baseline conditions is estimated to be $3,000,000 in the year 2000.

3.12.5.5 Employment

Non-farm employment in Wasatch County has steadily increased since 1987, rising an average of 4.5 percent a year through 1992 (U.S. Bureau of Economic Analysis 1994). Baseline conditions for the socioeconomic analysis assumed a 7 percent annual increase in existing employment (for a total of 7,846 jobs by the year 2000).

Baseline employment projections also assume continued retail trade employment growth and the emergence of tourism as an important industry. Through third quarter of calendar year 1995, non-farm employment growth was rising at a 7.7 percent annual rate, an increase of about 240 jobs.

Retail employment, which grew 12 percent in 1994 (Utah Department of Employment Security 1995b), is estimated to total 1,306 jobs in the year 2000 under baseline conditions. Construction employment rose 9.4 percent in 1994, representing a 7.8 percent increase in average monthly wages. Construction employment under baseline conditions is estimated to be 1,075 jobs in the year 2000. Farm sector employment was flat during the 1980s and through 1995 (Utah Department of Employment Security 1995b), totaling 430 jobs in 1980 and 432 in 1990, and projected to increase to 436 jobs by 2000 under baseline conditions.

3.12.5.6 Public Services and Related Fiscal Conditions

Public services and related fiscal conditions from 1990 to 1995 suggest an area in transition and struggling to meet the increasing needs of a growing community. This is reflected in increasing government sector employment and capital improvement programs. Wasatch County and Heber City services are characterized by staffing shortages, increasing capital programs and significant equipment replacement needs (Mountainland Association of Governments 1993b).

3.12.5.7 Housing

Baseline housing conditions are characterized by increasing housing costs and a shortage of housing, especially lower-cost homes. This is having a significant impact on low-income families (Mountainland Association of Governments 1993a and 1993c).

3.12.5.8 Social Conditions

This section describes baseline social groups and conditions that would likely be affected by the Proposed Action. . These groups, consisting of individuals who would be affected in a similar manner, overlap because some people have interests and concerns that place them in more than one group. For example, a farmer may be a recreationist, conservationist or local property owner as well as the owner of a farming enterprise that would be affected by the Proposed Action and alternatives. Members within each social group would likely experience common impacts on their lifestyles, behavior, attitudes, values and general well-being.

3.12.5.8.1 Social Groups. The following social groups are addressed in this analysis and described in this section:

- Farmers and their employees
- Other local business owners and their employees
- Local residents and property owners
- Recreationists and conservationists

Farmers are prominent and influential in Heber Valley and in Wasatch County politics. Typical concerns of farmers are the productivity and economic viability of agricultural operations, protection of water supplies, and privacy in terms of personal privacy and protecting their operations from incompatible land uses. Farmers value the land, understand agriculture's place in the environment (e.g., its effects on water resources, wetlands and habitat), and often have strong feelings for freedom and self-reliance.

Wasatch County is home to many businesses such as hotels and motels, service stations, and eating and drinking establishments that generate income from residents and visitors. Local business owners are generally concerned about activities that affect their business. While some business owners still depend on agriculture, many increasingly depend on non-agricultural customers, especially local residents who work in other counties and visitors attracted to Wasatch County's natural and recreational amenities.

Local residents and property owners reflect a mixture of attitudes and interests. Both long-term residents and newcomers value the community's small size and rural character. Some may be concerned that these attributes are starting to erode and, therefore, may be more sensitive to growth and its effects than residents of larger communities or local residents who favor growth For residents accustomed to the smaller, more rural and more homogeneous community of the past, growth has created a perception that the quality of life and community well-being is diminishing in Heber Valley. Other Heber Valley residents value change that assures economic well-being for generations to come. This group tends to accept some loss of small-town character in exchange for economic development. Local residents as a whole value personal privacy and are protective of their property value.

Recreationists and conservationists, whether living in Wasatch County or elsewhere, are well-represented by both individuals and formal interest groups that are actively involved in water and environmental issues that concern the county. They generally support measures that promote the efficient use of and long-term protection of natural resources and some are very interested in enhancing environmental conditions and recreational opportunities in the impact area of influence.

3.12.5.8.2 Community Well-Being. Changes in indicators of Wasatch County community well-being are mixed, based on data over the past decade. Per capita personal income has grown in real terms but has remained below the state average (Bureau of Economic and Business Research 1993a and 1995). At the same time, the percentage of families below the poverty line has remained steady or declined slightly (U.S. Bureau of the Census 1983a and 1994a). The percentage of Wasatch County residents who have completed high school increased by about 7 percent, a slightly higher rate of improvement than throughout the state. Nevertheless, educational attainment in Wasatch County is still somewhat below the state as a whole (U.S. Bureau of the Census 1983b and 1994b). Change in the county's crime rate, a key factor in public perception of community well-being, has been relatively favorable over the past decade, remaining the same or declining slightly while the crime rate rose statewide (U.S. Bureau of the Census 1983c and 1994c).

3.12.5.9 Growth-Inducing Forces

To the casual observer, Heber Valley is a rural community with a relatively homogeneous culture set amid picturesque farmlands and mountains. However, two decades or more of change have established trends that are transforming the economy, demography and social character of Wasatch County. These changes have been precipitated both internally and by its dynamic neighbors, Salt Lake County, Utah County, Summit County and people moving to Heber Valley from other states. The driving forces behind growth in Wasatch County and Heber Valley are population and employment growth in the state, on the Wasatch Front and in Summit County. Good road access to jobs on the Wasatch Front and Summit County, plus the prospect for improved road access, has encouraged in-migration. Other attractive features of Wasatch County and Heber Valley are the non-metropolitan quality of life, opportunity for outdoor recreation, a lower cost of living (including housing) than in the state's metropolitan areas, growth-accommodating land-use policies, and adequate public facilities and services. These features attract retirees, seasonal and second-home owners and working households.

Growth-inducing forces have caused unprecedented housing development in Wasatch County. According to data from the Bureau of Economic and Business Research at the University of Utah, 249 permits for new single-family dwelling units were issued in 1994, compared to an average of 60 per year from 1980 to 1989 and an average of 128 per year from 1990 to 1994 (Bureau of Economic and Business Research 1990, 1993b and 1995). County planning officials foresee as many as 5,800 new single-family dwelling units will be built in Wasatch County in the next 20 years, an average of 290 per year (Noffsinger, 1995).

3.12.6 Impact Analysis

3.12.6.1 Significance Criteria

3.12.6.1.1 Economic Impacts. Significant and adverse impacts on gross revenue, employment, income and fiscal conditions are defined as changes of 10 percent or more from baseline conditions. This percentage is considered by economists and planners to be a general threshold at which local government's ability to handle growth would be tenuous, and gross revenue, employment and income impacts would become significant. (Gross revenue is income from sales without considering costs associated with production.) Population, public service and housing impacts are considered significant if the project requires services that exceed available capacity of public services or housing under baseline conditions.

3.12.6.1.2 Social Impacts. Impacts on social groups and the individuals within them are considered significant when a change substantially disrupts a group's livelihood or lifestyle, or when there is a major conflict with the group's most important values or attitudes. Impacts on a community's well-being are considered significant when they lead to polarization and conflict among social groups, or a notable and negative change in the cohesion and stability of the community.

These criteria were selected from professional literature on social impact assessment (for example, see USFS 1973, Branch et al. 1982, and Burdge 1994 and 1995). The significance of social impacts was determined using professional judgment and considering the geographic context and intensity of impacts.

3.12.6.2 Potential Impacts Eliminated From Further Analysis

The following potential impacts were eliminated from further analysis:

- Would the Proposed Action and alternatives adversely affect housing in Heber Valley?

  Construction workers would commute from Salt Lake City, Provo and Orem and from residences in local communities and would not need housing in Heber Valley.

- Would the Proposed Action and alternatives adversely affect public services?

  Road repair, traffic control, wastewater services and social services would not be affected by the Proposed Action and alternatives. Maintenance of project facilities and recreation trailheads would be performed by WCSSA and the USFS, not by other public agencies. The transportation SOPs described in Section 1.12.9 of Chapter 1 include commitments to repair all damage to local roads from construction vehicles and to provide traffic control during construction. The Proposed Action and alternatives could affect crime prevention services as addressed in the public services-related sections below.

3.12.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

3.12.6.3.1 Population Impacts. The Proposed Action is not expected to increase the population of Heber Valley because it would only cause a minor increase in permanent employment opportunities.

3.12.6.3.2 Agricultural Economics Impacts. The following subsections present gross revenue impacts during construction and production cost and gross revenue impacts during operation.

3.12.6.3.2.1 Gross Revenue Impacts During Construction. Impacts on farm gross revenue during construction would be caused by lost revenue from lands temporarily and permanently affected during construction. Table 1-15 in Section 1.12.3.1 of Chapter 1 shows acreage of grazing land and cropland that would be temporarily and permanently disturbed during construction of the Proposed Action. Section 3.11, Agriculture, defines related production losses and Table 3-44 in this section summarizes impacts on gross revenue during construction of the Proposed Action.

3.12.6.3.2.2 Production Cost Impacts During Operation. During operation, the Proposed Action would cause an increase in both the fixed and variable costs of crop production. Fixed costs are defined as those that occur largely independent of the amount of crops produced. They include purchase and maintenance of mechanized equipment and irrigation system components, as well as land costs. The total increase in fixed costs for all 7,823

Table 3-44
Socioeconomic Impacts During Construction of the Proposed Action and Alternatives

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Impact Topic	Proposed Action	DRP With Pipeline Alternative	DRP With Canal Alternative
AGRICULTURAL GROSS REVENUE[1] LOST FROM GRAZING LAND AND CROPLAND (in dollars)			
Temporary Land Disturbance	41,067	15,884	8,712
Permanent Land Removal	2,684	88	1,085
TOTAL LOSS	43,751	15,972	9,797
Percent Change	**-2.5%**	**<-1.0%**	**<-1.0%**
GROSS PEAK ANNUAL REVENUE IN RETAIL TRADE SECTOR (in dollars)			
Baseline Retail Trade Sector Revenue[2,3]	70,453,000	70,453,000	70,453,000
Revenue With Proposed Action and Alternatives[4]	71,166,000	70,834,000	70,620,000
Increase	693,000	381,000	162,000
Percent Change	**< 1.0%**	**< 1.0%**	**< 1.0%**
TOTAL GROSS PEAK ANNUAL REVENUE IN WASATCH COUNTY (in dollars)			
Baseline Total Gross Revenue in Wasatch County[2,4]	120,673,000	120,673,000	120,673,000
Revenue With Proposed Action and Alternatives	121,322,000	121,038,000	120,825,000
Increase	649,000	365,000	152,000
Percent Change	**< 1.0%**	**< 1.0%**	**< 1.0%**
PEAK ANNUAL INCOME IMACTS WITHIN SECTORS (in dollars)			
Baseline Construction Sector Income[2,3]	21,108,000	21,108,000	21,108,000
Income With Proposed Action and Alternatives	23,323,000	21,829,000	22,123,000
Increase	2,215,000	721,000	1,015,000
Percent Change	**+10.5%**	**+3.4%**	**+4.8%**
Baseline Retail Trade Sector Income[2,3]	12,168,000	12,168,000	12,168,000
Income With Proposed Action and Alternatives[4]	12,307,000	12,244,000	12,200,000
Increase	139,000	76,000	32,000
Percent Change	**+1.1%**	**< 1.0%**	**< 1.0%**
Baseline Farm Sector Income	3,000,000	3,000,000	3,000,000
Income With Proposed Action and Alternatives	2,990,000	2,996,000	2,998,000
Decrease	-10,000	-4,000	-2,000
Percent Change	**< -1.0%**	**< -1.0%**	**< -1.0%**

Table 3-44
Socioeconomic Impacts During Construction of the Proposed Action and Alternatives

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Impact Topic	Proposed Action	DRP With Pipeline Alternative	DRP With Canal Alternative
TOTAL PEAK ANNUAL INCOME IN WASATCH COUNTY			
Baseline Total Income in Wasatch County[2,3]	116,366,000	116,366,000	116,366,000
Total Income With Proposed Action and Alternatives	118,710,000	117,159,000	117,411,000
Increase	2,344,000	793,000	1,045,000
Percent Change	**+2.0%**	**< 1.0%**	**< 1.0%**
EMPLOYMENT (Jobs)			
Total Number of Temporary Jobs During Construction	83	48	58

Notes:

[1] Gross revenue is income from sales without considering costs associated with production
[2] Source: State of Utah Department of Employment Security, 1995b
[3] Source: U.S. Bureau of Economic Analysis, 1994
[4] Reflects changes in revenue to materials suppliers, gasoline retailers and retail businesses

Table 3-45
Socioeconomic Impacts During Operation of the Proposed Action and Alternatives

Page 1 of 2

Impact Topic	Proposed Action	DRP With Pipeline Alternative	DRP With Canal Alternative
AGRICULTURAL GROSS ANNUAL REVENUE (in dollars)			
Baseline	1,752,837	1,752,837	1,752,837
Total With Proposed Action and Alternatives	1,883,722	1,751,659	1,735,720
Change	130,885	-1,178	-17,117
Percent Change	**+7.5%**	**<-1.0%**	**-1.0%**
GROSS ANNUAL REVENUE IN RETAIL TRADE SECTOR (in dollars)			
Baseline Retail Trade Sector Revenue[1,2]	70,453,000	70,453,000	70,453,000
Revenue With Proposed Action and Alternatives	70,597,000	70,547,000	70,547,000
Increase	94,000	94,000	94,000
Percent Change	**< 1.0%**	**< 1.0%**	**< 1.0%**
TOTAL ANNUAL GROSS REVENUE IN WASATCH COUNTY (in dollars)			
Baseline Total Gross Revenue in Wasatch County[1,2]	120,673,000	120,788,000	120,771,000
Revenue With Proposed Action and Alternatives[3]	120,989,000	120,906,000	120,873,000
Increase	316,000	118,000	102,000
Percent Change	**< 1.0%**	**< 1.0%**	**< 1.0%**
ANNUAL INCOME IMPACTS WITHIN SECTORS (in dollars)			
Baseline Farm Sector Income[1,2]	3,000,000	3,000,000	3,000,000
Income With Proposed Action and Alternatives	3,026,000	3,000,000	2,997,000
Change	26,000	0	-3,000
Percent Change	**<1.0%**	**0.0%**	**< 1.0%**
Baseline Retail Trade Sector Income[1,2]	12,168,000	12,168,000	12,168,000
Income With Proposed Action and Alternatives	12,184,000	12,184,000	12,184,000
Increase	16,000	16,000	16,000
Percent Change	**< 1.0%**	**< 1.0%**	**< 1.0%**
TOTAL ANNUAL INCOME IN WASATCH COUNTY			
Baseline Total Income in Wasatch County[1,2]	116,366,000	116,366,000	116,366,000
Income With Proposed Action and Alternatives	116,408,000	116,382,000	116,379,000
Increase	42,000	16,000	13,000
Percent Change	**< 1.0%**	**< 1.0%**	**< 1.0%**

Table 3-45
Socioeconomic Impacts During Operation of the Proposed Action and Alternatives

Page 2 of 2

Impact Topic	Proposed Action	DRP With Pipeline Alternative	DRP With Canal Alternative
EMPLOYMENT (Jobs)			
Baseline Farm Sector Jobs[1,2]	436	436	436
Jobs With Proposed Action and Alternatives	442	436	436
Increase	6	0	0
Percent Change	**+1.4%**	**0.0%**	**0.0%**
Baseline Retail Trade Sector Jobs[1,2]	1,306	1,306	1,306
Jobs With Proposed Action Alternatives	1,310	1,310	1,310
Increase	4	4	4
Percent Change	**<1.0%**	**<1.0%**	**<1.0%**
Baseline Total Wasatch County Jobs[1,2]	7,846	7,846	7,846
Jobs With Proposed Action and Alternatives	7,856	7,850	7,850
Increase	10	4	4
Percent Change	**<1.0%**	**<1.0%**	**<1.0%**

Notes:

[1] Source: State of Utah Department of Employment Security 1995b
[2] Source: U.S. Bureau of Economic Analysis 1994
[3] Includes Gross Energy Sales of $91,000 and $25,000 for the Proposed Action and DRP altenratives, respectively

affected acres is estimated to be $80,796 per year (8.0 percent) due to conversion from flood to sprinkler irrigation. Variable costs are defined to include irrigation water, seed, fertilizer, pesticides, cultivation and labor. The total increase in variable costs for all affected acreage is estimated to be $42,772 (7.5 percent) due to an increase in fertilization rates associated with slightly higher crop yields and higher irrigation water costs.

*3.12.6.3.2.3 **Gross Revenue Impacts During Operation.*** Table 3-45 shows a net increase in annual gross revenue from crop production after construction of the Proposed Action because of higher crop yields associated with the conversion from flood to sprinkler irrigation. The Proposed Action also would cause a minor annual loss in gross revenue after construction from the loss of production on grazing land and cropland permanently removed during construction. This loss of revenue would be offset by the much larger increase in revenue associated with higher crop yields. Because of the dispersed nature of the affected areas, impacts on individual farm enterprises also would be minor.

Even though the cost of production would be higher under the Proposed Action, the increase in gross revenue is expected to more than offset the higher production costs. The amount of net profit would vary by farming enterprise, depending on such considerations as cropping patterns, water supplies and individual management practices.

3.12.6.3.3 Regional Economic Benefits. The FWS has estimated the regional economic benefits related to the increase in recreation use caused by the Proposed Action (FWS 1996). These economic benefits would occur in a broad region when recreation use increases in the Strawberry River basin, other portions of the Uinta basin and possibly other areas. Trout populations are expected to increase in these areas when: 1) flows are restored in the upper Strawberry River basin, 2) trout currently stocked in Strawberry Reservoir are reallocated from the hatchery to other waters after the natural reproduction of fish is re-established in the reservoir, and 3) streamflows increase in Uinta basin streams, other than the upper Strawberry River.

The FWS estimates there would be an increase of 1,914 angler days when streamflows increase in Uinta basin streams other than the upper Strawberry River, and another increase of 201,946 angler days would occur when the trout currently stocked in Strawberry Reservoir are reallocated. The FWS has estimated the regional economic benefits of the total 203,860 increase in angler days would be $5,292,205.54 per year. This estimate of regional economic benefits was conducted using a unit value of $25.96 per angler day (FWS 1996). As further explained in Section B.1.11.2.3 of Appendix B, this angler day unit value is of a different type than the one used below in Section 3.12.6.3.4 to estimate the expenditures of recreationists in Wasatch County.

3.12.6.3.4 Gross Revenue Impacts in the Retail Trade Sector. Tables 3-44 and 3-45 show potential gross revenue impacts of the Proposed Action. During construction, gravel and concrete are expected to be obtained from local sources, increasing the gross revenue of retail businesses. Pipe material would likely be provided by sources in Salt Lake and Utah counties, and would not affect income in the impact area of influence. The Proposed Action also would cause some unavoidable disruptions to businesses along pipeline routes. These businesses are part of the retail trade sector. While the SOPs call for continued access to businesses during construction there will likely be some interruption to businesses along these routes from temporary detours of traffic and customers wishing to go to businesses with easier access.

The gross revenue of businesses in the retail trade sector is expected to increase during operation as more recreationists are attracted to restored Strawberry River and other Uinta basin streams under the Proposed Action. While it is not possible at this time to specify the communities and counties that would experience positive revenue impacts, it is likely that some of the recreationists would spend money in Wasatch County on their way to areas that experience an increase in trout populations. The increase in the number of anglers expected to travel through Wasatch County on their way to fish in the Strawberry River and the Uinta basin streams is projected to add more than $94,000 a year to retail trade gross revenue, assuming only 3 percent of these recreationists purchase gas, food and supplies in Wasatch County at an average of $18.40 per angler day. Other recreationists would spend money outside Wasatch County. Very few recreationists would be attracted to the five Heber Valley streams enhanced under the Proposed Action because access would not be provided. The Proposed Action would not cause changes in recreation use along Daniels Creek since baseline levels of stocking would be maintained despite reduced flows.

3.12.6.3.5 Total Gross Revenue Impacts. Gross revenue is expected to increase in Wasatch County during the construction and operation phases of the Proposed Action and alternatives. During construction of the Proposed Action, the peak annual increase would be about $649,000, or less than a 1 percent increase. The total increase over the construction period is expected to be about $713,000. During operation of the Proposed Action, total gross revenue in Wasatch County is expected to increase by about $316,000 per year, or less than 1 percent. This includes $91,120 a year in additional revenue for the local electrical utility to run the Proposed Action's pumping stations and for the additional energy needed to pump groundwater.

3.12.6.3.6 Income Impacts Within Sectors. Tables 3-44 and 3-45 show potential income impacts by economic sector. During construction, increases in gross revenue from the sale of construction materials is expected to increase the income of related businesses. Pipe material is expected to be provided by sources in Salt Lake and Utah counties, and would not affect income in Heber Valley. Retail trade income is expected to drop slightly for businesses that are disrupted during construction. Farm income also would decrease during construction as crop and grazing lands are temporarily disturbed and permanently removed.

Recreationists on their way to the restored Strawberry River and other Uinta basin streams are expected to increase Heber Valley retail trade income by approximately $16,000 a year. Farm income is expected to increase slightly as agricultural production increases under the Proposed Action. Gross farm revenue is expected to increase by $130,885 a year, resulting in an increase in regional farm income of $26,000 per year.

3.12.6.3.7 Total Income Impacts. Increases in regional income are expected during construction and operation of the Proposed Action and alternatives. During construction, peak annual regional income is expected to increase by approximately $2,344,000, or 2.0 percent. The total increase in income over the construction period is expected to be about $2,421,000. During operation, regional income is expected to increase by about $42,000 per year, or less than 1 percent of total Wasatch County income. Land values also may increase along the five Heber Valley streams that would receive supplemental instream flows under the Proposed Action, which could increase landowner income if they sell their property.

3.12.6.3.8 Employment Impacts. About 83 temporary jobs would be created during construction of the Proposed Action. During operation, one full-time O&M laborer and three part-time O&M staff would be employed by WCSSA (see Table 1-18 in Section 1.12.3 of Chapter 1). Farm employment is expected to increase by approximately six jobs — a 1.4 percent increase in baseline farm employment — because sprinkler systems require more labor to maintain than flood irrigation. The increase in retail trade income described in 3.12.6.3.3 would also result in an estimated increase of about four jobs, which is less than a 1 percent increase in retail employment. Total Wasatch County employment is expected to increase less than 1 percent (see Table 3-45).

3.12.6.3.9 Public Services and Related Fiscal Impacts. Impacts on public services are not expected, with one minor exception. Local law enforcement agencies, such as the sheriff's office or Heber City Police Department, may need to respond to a small number of additional trespassing complaints and vandalism along the five Heber Valley streams that receive supplemental instream flows. An increase in crime also is possible in the Strawberry Valley, especially at trailheads and parking areas. Overall, the impact on crime prevention services is expected to be minor.

The Heber City Public Works Department is responsible for construction and maintenance of city roads. The present lack of curbs and gutters leads to drainage problems in many areas, but the city anticipates installing curbs and gutters at a cost of about $6 to $7 million when the city installs the secondary irrigation water system that would be facilitated by the Proposed Action. This is a planned expense and capital improvement of Heber City.

The increase in gross revenue would cause a peak annual increase in local and state sales tax revenue of about $21,000 a year during construction and $9,000 a year during operation. State and federal income tax revenue also would increase as income increases. Local property tax revenue would increase if property values along the five Heber Valley streams increase. Under the Proposed

Action, 150.5 acres of private property would be acquired (see Table 1-14 in Chapter 1, Section 1.12.3.1). Federal payments in lieu of taxes would begin for these acquired lands when the Proposed Action is constructed, assuming Wasatch County is still eligible for such payments. Assuming the payments are $1.11 per acre per year (BLM 1996), the net decrease in property tax revenue would be $55,289 per year. This analysis uses a worst-case approach by assuming the land would be acquired by fee title and not easements.

3.12.6.3.10 Growth-Inducing Impacts. As described in Section 3.12.5, major growth-inducing forces under existing conditions are expected to continue under baseline conditions. The Proposed Action is not expected to induce additional growth in Heber Valley because it would not: 1) change any growth-inducing forces, 2) create a significant number of new job opportunities in Heber Valley or in the areas people commute to from Heber Valley, 3) cause development of new housing, 4) change the affordability of housing, 5) significantly improve the quality of life in Heber Valley, or 6) change land use zoning laws or policies.

3.12.6.3.11 Social Impacts

3.12.6.3.11.1 Farmers and Their Employees. Some farmers and their employees would be displeased by temporary disturbances to their operations and adverse noise, visual and dust impacts during construction. Permanent restrictions of some land uses on ROWs after construction (no permanent structures or roads would be allowed) may interfere with future plans of some farmers, although farming would be allowed to continue on ROWs. Some farmers and their employees also may be annoyed by fishermen who trespass and litter along Heber Valley streams enhanced by the Proposed Action. However, over the long-term increased production and income associated with the conversion to sprinkler irrigation would please farmers who would benefit. This could have a minor and positive impact on their disposable incomes and lifestyles.

3.12.6.3.11.2 Other Local Business Owners and Their Employees. Many other local business owners would enjoy increased income during construction as materials are purchased (especially gravel at a local quarry site) and construction workers purchase food and fuel. A few business owners and their employees would be adversely affected if pipeline trenching and other construction procedures temporarily reduce business. Recreationists stopping in Heber Valley on their way to the Strawberry River basin after construction would likely raise the income of local business owners and their employees by purchasing food, fuel, sporting goods and other items. This would have a positive impact on the disposable incomes and lifestyles of affected business owners and employees.

3.12.6.3.11.3 Local Residents and Property Owners. Some local property owners and residents would be adversely affected during construction of the Proposed Action, while others would experience positive impacts. Those who would be negatively affected would be upset by such nuisances as noise, dust and traffic impacts. Some would be required to sell portions of their property for ROWs or provide temporary easements for construction access. Unwilling sellers would resent imposition and control on their property rights and their sense of independence. Beneficial impacts would accrue to local residents who experience positive employment impacts from the Proposed Action.

During operation, there would be positive effects on the well-being of local residents and property owners who experience direct or indirect increases in income and employment opportunities. Property owners along the five enhanced streams in Heber Valley may benefit from increased property values as fishing improves next to other property and views improve due to increased riparian vegetation. Some residents and property owners along the streams would be adversely affected by fishermen who may trespass, litter and vandalize their property or engage in other nuisance behavior. It is expected, however, that the number of such incidents will be limited since no access will be provided. Some residents may also experience increased well pumping costs due to a lower water table. Future development plans of some property owners also may be altered by land-use restrictions on Proposed Action ROWs.

3.12.6.3.11.4 Recreationists and Conservationists. Recreationists and conservationists would be mostly satisfied by the completion and operation of the Proposed Action because it would achieve several objectives important to these groups, including additional recreation opportunities in the Strawberry River basin and other areas. Conservationists and interest groups that represent them would be pleased by the restoration of upper Strawberry River basin streams, enhancement of five Heber Valley streams, and the water conservation features of the Proposed Action.

3.12.6.3.11.5 Community Well-Being. The relatively small number of construction workers and vehicles, as well as the nature of construction procedures, would help avoid most potential negative impacts on the overall well-being of Heber Valley communities during construction. However, there could be a minor increase in conflicts among social groups as some farmers, residents or property owners experience the negative impacts described above but do not experience any beneficial impacts from the Proposed Action. After construction, there would be a potential for conflict among recreationists from urban areas and members of Heber Valley communities. However, the intensity of such conflicts and likelihood of polarization among social groups would be too minor to significantly affect community cohesion and stability.

3.12.6.3.12 Impact Summary. Construction of the Proposed Action would cause adverse impacts on gross farm revenue and on some farmers, local residents and property owners. Positive employment and income impacts would occur during construction for the construction and retail sectors of the economy and for some people directly and indirectly affected, including local business owners, their employees and some local residents. During operation, the Proposed Action is expected to increase gross farm revenue and the profitability of some farms. The owners and employees of businesses that would serve recreationists traveling to the Strawberry River basin and other areas would experience positive income impacts.

3.12.6.4 Daniel Replacement Project With Pipeline Alternative

The major socioeconomic impacts of constructing and operating this alternative are summarized in Tables 3-44 and 3-45.

3.12.6.4.1 Population Impacts. This alternative is not expected to increase the population of Heber Valley because it would only cause a minor increase in permanent employment opportunities.

3.12.6.4.2 Agricultural Economics Impacts. The following subsections present gross revenue impacts during construction and production cost and gross revenue impacts during operation.

3.12.6.4.2.1 Gross Revenue Impacts During Construction. The impacts on gross revenue from constructing this alternative are summarized in Table 3-44.

3.12.6.4.2.2 Production Cost Impacts During Operation. This alternative would cause a minor decrease in fixed and variable crop production costs. The lower fixed costs of about $2,418 a year (or 0.2 percent) would result from a small reduction in cost associated with alfalfa planting. The lower variable costs of about $12,923 a year (or 1.6 percent) would result from a decrease in the water supply of irrigation companies other than DIC and associated smaller annual costs.

3.12.6.4.2.3 Gross Revenue Impacts During Operation. Operation of this alternative would cause a minor decrease in annual gross revenue of about $1,178 a year, or less than 1 percent. This would result from a small reduction in crop production because of lower water supplies and loss of production on lands permanently removed for facility ROW. Net profit under this alternative would be about the same as baseline conditions since lower gross revenue is accompanied by a slight reduction in production costs.

3.12.6.4.3 Regional Economic Benefits. The regional economic benefits described in Section 3.12.6.3.3 also apply to the DRP With Pipeline Alternative.

3.12.6.4.4 Gross Revenue Impacts in the Retail Trade Sector. Potential impacts on gross revenue are presented in Tables 3-44 and 3-45.

3.12.6.4.5 Total Gross Revenue Impacts. Gross revenue for retail trade and construction is expected to increase in Wasatch County during construction and operation of this alternative. During construction, the peak annual increase in total gross revenue would be about $365,000, or less than 1 percent. Total gross revenue over the construction period would increase by approximately $365,000. During operation, total gross revenue in Wasatch County would increase by about $118,000 a year, or less than 1 percent. This includes a $24,960 a year increase in gross revenue for the local electric utility since additional energy would be needed to run pumping stations.

3.12.6.4.6 Income Impacts Within Sectors. Potential impacts to income are presented in Tables 3-40 and 3-41. During construction of the DRP With Pipeline Alternative, income in the construction, farm and retail sectors is expected to increase. During operations, farm income is expected to decrease slightly and retail trade income is expected to increase. Farm income would decrease due to a reduction in gross revenue from permanently removed lands and a reduction in water supplies.

3.12.6.4.7 Total Income Impacts. This alternative would increase total income in Wasatch County during construction. The total increase would be by about $793,000, or less than 1 percent. During operation, the increase in retail income is expected to be larger than the decrease in farm sector income. The net increase in Wasatch County income is expected to be about $45,000, or less than 1 percent of total Wasatch County income.

3.12.6.4.8 Employment Impacts. During construction of this alternative, temporary employment opportunities are expected to increase by 48 construction jobs. During operation, retail trade employment is expected to increase, but less than 1 percent on a regional basis.

3.12.6.4.9 Public Services and Related Fiscal Impacts. The increase in gross revenue during construction would increase both local and state sales tax revenue. The peak annual increase would be about $11,000, while the increase in gross revenue during operation is expected to increase local and state sales tax revenue by about $3,000 a year. State and federal income tax revenue also would increase as income increases. Under the DRP With Pipeline Alternative, 53.6 acres of private property would be acquired (see Table 1-10 in Chapter 1, Section 1.8.3). Federal payments in lieu of taxes would begin for these acquired lands when this alternative is constructed, assuming Wasatch County is still eligible for such payments. Assuming the payments are $1.11 per acre per year (BLM 1996), the net decrease in property tax revenue would be $19,691 per year.

An increase in crime is possible in the upper Strawberry River basin, especially at trailheads and parking areas. However, related impacts on crime prevention services in the impact area of influence would be minor.

3.12.6.4.10 Growth-Inducing Impacts. This alternative is not expected to induce growth because it would not affect any growth-inducing forces already occurring in Heber Valley.

3.12.6.4.11 Social Impacts

3.12.6.4.11.1 Farmers and Their Employees. The social impacts on farmers from this alternative would be similar to those described for the Proposed Action in Section 3.12.6.3.11.1, except the DRP With Pipeline Alternative would require less disturbance and acquisition of agricultural land than the Proposed Action and would not lead to potential impacts along the Heber Valley streams enhanced under the Proposed Action. This alternative would reduce the availability of water supplies and cause a minor reduction in gross revenue for farmers who are not in the DIC service area. Although the revenue reduction is expected to be small, many farmers would likely be concerned about this because they highly value their water supplies and would be opposed to anything that reduces the productivity and profitability of their operations.

3.12.6.4.11.2 Other Local Business Owners and Their Employees. The impacts during operation of this alternative would be the same as described for the Proposed Action in Section 3.12.6.3.11.2. Impacts on local business owners other than farmers during construction of this alternative would be similar to but less than those under the Proposed Action because there would be no spending for sprinkler equipment, less spending on borrow and other construction material, and less spending for food, fuel and miscellaneous items by construction workers.

3.12.6.4.11.3 Local Residents and Property Owners. The same types of impacts described for the Proposed Action in Section 3.12.6.3.11.3 would occur during construction of this alternative. However, the magnitude of these impacts would be less because less area would be disturbed, less land acquired, and there would be fewer employment opportunities for local residents.

3.12.6.4.11.4 Recreationists and Conservationists. Recreationists and conservationists would be pleased with additional recreation opportunities and environmental improvements in the upper

Strawberry River basin and other areas under this alternative. Some conservationists have helped develop the supplemental instream flows included in the Proposed Action, and others stated their support during the scoping process for enhancing the habitat of Heber Valley streams. They would be disappointed if supplemental streamflows were not implemented because the Proposed Action was not implemented.

3.12.6.4.11.5 ***Community Well-Being.*** The impacts on community well-being would be the same as described for the Proposed Action in Section 3.12.6.3.11.5. This alternative could cause additional conflicts related to reduced water supplies and income for Heber Valley farmers who are not in the DIC service area.

3.12.6.4.12 Impact Summary. Construction of the DRP With Pipeline Alternative would cause adverse impacts on gross farm revenue and on some farmers, local residents and property owners. Positive employment and income impacts would occur during construction for the construction and retail sectors of the economy and for some people directly and indirectly affected, including local business owners, their employees and some local residents. During operation, this alternative is expected to cause a minor decrease in the gross revenue of some farms. The owners and employees of businesses that would serve recreationists traveling to the Strawberry River basin and other areas would experience positive income impacts.

3.12.6.5 Daniel Replacement Project With Canal Alternative

The major socioeconomic impacts of constructing and operating this alternative are summarized in Tables 3-44 and 3-45.

3.12.6.5.1 Population Impacts. The DRP With Canal Alternative is not expected to increase the population of Heber Valley because it would only cause a minor increase in permanent employment opportunities.

3.12.6.5.2 Agricultural Economics Impacts

3.12.6.5.2.1 ***Gross Revenue Impacts During Construction.*** Gross revenue impacts during construction of this alternative are summarized in Table 3-44.

3.12.6.5.2.2 ***Production Cost Impacts During Operation.*** This alternative would cause a minor decrease in fixed and variable crop production costs. The lower fixed costs of about $2,966 a year (or 0.3 percent) would result from a small reduction in the annual fixed cost associated with the establishment of the alfalfa planting. The lower variable costs of about $14,418 a year (or 1.8 percent) would result from a decrease in the water supply of irrigation companies other than DIC and associated smaller annual costs.

3.12.6.5.2.3 ***Gross Revenue Impacts During Operation.*** Operation of this alternative would cause a minor decrease in annual gross revenue (about $17,117 a year). This drop of about 1.0 percent would result from a small reduction in crop production from lower water supplies and the loss of production on lands permanently removed for facility ROW.

Net profit under this alternative would be about the same as baseline conditions since the lower gross revenue is accompanied by a slight reduction in production costs.

3.12.6.5.3 Regional Economic Benefits. The regional economic benefits described in Section 3.12.6.3.3 also apply to the DRP With Canal Alternative.

3.12.6.5.4 Gross Revenue Impacts in the Retail Trade Sector. The potential impacts on gross revenue under the DRP With Canal Alternative are presented in Tables 3-44 and 3-45. Retail trade gross revenue is expected to increase during construction. During operation, retail trade gross revenue is expected to increase as more recreationists travel through Wasatch County.

3.12.6.5.5 Total Gross Revenue Impacts. During construction, the peak annual increase in total Wasatch County gross revenue would be about $152,000, or less than 1 percent. Total gross revenue over the construction period is expected to increase by approximately $152,000. During operation, total gross revenue in is expected to increase by about $102,000 per year, or less than 1 percent. This includes a $24,960 a year increase in gross revenue for the local energy utility.

3.12.6.5.6 Income Impacts Within Sectors. The potential impacts on income under the DRP With Canal Alternative is summarized in

Tables 3-44 and 3-45. During construction of this alternative, income in the construction, farm, and retail sectors is expected to increase. During operations, farm income is expected to decrease slightly and retail trade income is expected to increase. Farm income would decrease because of a reduction in gross revenue from permanently removed lands and a reduction in water supplies.

3.12.6.5.7 Total Income Impacts. Construction of this alternative would increase total Wasatch County income by about $1,077,000, or less than 1 percent. During operation, the increase in retail income is expected to be larger than the decrease in farm sector income. The net increase in Wasatch County income is expected to be about $13,000, or less than 1 percent of total income.

3.12.6.5.8 Employment Impacts. Construction employment under this alternative is expected to increase by 58 jobs. A minor increase in retail trade employment is expected during operation.

3.12.6.5.9 Public Services and Related Fiscal Impacts. The public services and fiscal resource impacts of this alternative would essentially be the same as described for the DRP With Pipeline Alternative in Section 3.12.6.4.9. However, the increase in local and state sales tax revenue during construction would be less (about $5,000). Under the DRP With Canal Alternative, 111.3 acres of private property would be acquired (see Table 1-14 in Chapter 1, Section 1.12.3.1). Federal payments in lieu of taxes would begin for these acquired lands when this alternative is constructed, assuming Wasatch County is still eligible for such payments. Assuming the payments are $1.11 per acre per year (BLM 1996), the net decrease in property tax revenue would be $40,888 per year.

3.12.6.5.10 Growth-Inducing Impacts. This alternative is not expected to induce growth because it would not affect any growth-inducing forces already occurring in Heber Valley.

3.12.6.5.11 Social Impacts. The social impacts of this alternative would essentially be the same as described for the DRP With Pipeline Alternative in Section 3.12.6.4.11.

3.12.6.5.12 Impact Summary. The impact summary for this alternative is the same as described for the DRP With Pipeline Alternative in Section 3.12.6.4.12.

3.12.6.6 No Action Alternative

The No Action Alternative would not cause impacts on socioeconomic conditions in the impact area of influence because the socioeconomic baseline conditions described in Section 3.12.5 would continue.

3.13 Health and Safety

3.13.1 Introduction

The health and safety analysis addresses potential public safety hazards and health risks from the construction and operation of the Proposed Action and alternatives. The methodology used to conduct the health and safety analysis is described in Appendix B, Section B.2.12. The following impact topics are addressed in the analysis:

- Health and safety hazards during construction
- Stream and canal flood risks
- Potential failures of pipelines, canals and regulating ponds
- Other potential hazards during operation

3.13.2 Issues Eliminated From Further Analysis

The following health and safety issues raised during scoping and defined in Section 3.13.3 were eliminated from further analysis:

- What effects would occur to public safety from providing instream flows to Lake Creek through the middle of Heber City?

- Would Heber City be susceptible to flooding from instream water being supplied to Lake Creek?

These issues are not related to the Proposed Action and alternatives because they would not provide instream flows to Lake Creek upstream of Heber City. Therefore, they are eliminated from further analysis.

3.13.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the health and safety impact analysis:

- What health and safety impacts could occur from use of existing canals for water distribution as more homes are built around the canals?
- What would be the health and safety impacts of enlarging existing canals as more single-family homes are built in Heber Valley?
- How would the Proposed Action affect canal abandonment from construction of pipelines, and what would happen to abandoned canals that currently provide flood control throughout Heber Valley?
- What effects would occur to public health and safety from increasing instream flows to streams and conveyance of those flows through canals?
- What impacts would occur on public health and safety from accidental breaching of the Timpanogos Canal?
- How would project construction and operation and maintenance activities affect public health and safety?
- What impacts would occur to people living downhill of the Daniel Replacement pipeline if it breaks or ruptures?

3.13.4 Description of Impact Area of Influence

The impact area of influence for the health and safety analysis includes the following: areas where the Proposed Action and alternatives would be constructed; areas near new pipelines; regulating ponds and canals that would be modified or would be used to convey water; roads used for construction; O&M or recreation traffic; and areas near Heber Valley streams that would receive supplemental flows under the Proposed Action.

3.13.5 Affected Environment (Baseline Conditions)

The health and safety baseline conditions defined in this section are mostly existing conditions, although most or all of these conditions are expected to be present in the future when the Proposed Action and alternatives are constructed and operated.

The most notable health and safety hazards under baseline conditions are traffic-related hazards, especially on and near the state highways in Heber Valley (Highways 40, 113 and 189). Schools, residences and many businesses are adjacent to or near these highways.

Flooding hazards in Heber Valley are mainly associated with spring snowmelt runoff and accidental failures of existing canal embankments. During spring, snow melts rapidly over a short period of time when temperatures rise. Runoff flows across the surface and collects in roadside and irrigation ditches, then into canals, which are the primary facilities to channel and convey runoff through the valley, other than local creeks. The irrigation ditches provide an important flood control benefit by routing runoff to local creeks that have capacity to convey the water to the Provo River. The principal creeks in Heber Valley that help route local runoff to the Provo River are Snake and Berkenshaw creeks on the west side of the valley, and Lake, Center, Daniels and Spring creeks on the east side of the river.

A flood control channel or floodway was recently constructed in Heber Valley to improve routing of high flows to the Provo River (see locations of floodway and irrigation canals on Map A-1 in pocket in back of EIS). The channel begins at the Center Creek crossing of the Humbug Canal.

Existing canals have experienced embankment failures during high inflow from mountain slopes, causing small, localized flooding of farmland primarily along the Timpanogos Canal north of Center Street. This reach is located along a steep cross-slope that collects drainage from the mountainside.

Although no major widespread flooding has been reported along local drainages in Heber Valley, overland flows across fields have entered basements that are not waterproof. Localized flooding has occurred in more than 50 percent of the historic hydrologic record. Flood control in Heber Valley is the responsibility of individual landowners, and recent development has altered drainage paths and concentrated flows in some areas.

3.13.6 Impact Analysis

3.13.6.1 Significance Criteria

Any increase in the risk of flooding from streams and canals was considered significant if the risk of flooding exceeded the magnitude, duration and frequency of flooding under natural flow conditions or under baseline conditions.

Other potential health and safety hazards associated with the Proposed Action and alternatives were considered significant if the proposed SOPs would not minimize the risks of accidents to acceptable levels that are typical of projects of this type.

3.13.6.2 Potential Impacts Eliminated From Further Analysis

None of the issues raised during scoping have been eliminated from further analysis.

3.13.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following sections define potential health and safety impacts during construction and operation of the Proposed Action.

3.13.6.3.1 Construction Hazards. Construction of the Proposed Action would cause a minor increase in the risk of accidents and safety hazards for construction workers and people who travel the same roads as construction traffic. However, the health and safety, transportation, air quality and noise SOPs defined in Section 1.12.9 of Chapter 1 would minimize the risks of construction hazards. The SOPs would reduce the risk of accidents to acceptable levels.

The construction contract would require the contractor to protect the work area from flooding and safely pass drainage across the work area. The contractor also would be required to construct temporary dirt ditches, culverts and berms within the work area to route irrigation water and runoff across the work area. CUWCD inspectors would verify the adequacy of ditches and ensure they are in place at the end of the work day to accommodate irrigation flows during the night. Construction of facilities across stream channels also would be timed to occur during periods of minimal flood risks. To minimize the possibility of increasing flood hazards, the construction contract would address all foreseeable construction activities that could affect the risk of flooding.

3.13.6.3.2 Hazards Related to Flooding From Streams and Canals. The Proposed Action would supplement the low flows of five Heber Valley streams, which are at their most hazardous levels during spring runoff. The Proposed Action would not change this situation. The new flow regimes would be similar to natural conditions, providing continuous and relatively low flows to these streams, which would be relatively shallow and generally less than 1 foot deep except in pools. All of these streams, except lower Lake Creek, have flows during the summer and fall under baseline conditions. Supplemental water would not be discharged into the streams when flows are equal to or greater than the target flows listed in Table 1-12 in Section 1.8.5 of Chapter 1.

The Proposed Action would likely decrease the risk of flooding in Heber Valley from streams and canals because it would structurally improve some canals; increase the height of canal embankments above maximum operating water level (called freeboard); and make additional capacity available in some existing canals and ditches by conveying water in new pipelines and modified canals. Since the Proposed Action would not decrease the capacity of any existing canals, all of the affected canals would have the same or greater flood control capability compared to baseline conditions.

Improved and centrally coordinated management of the water delivery system in Heber Valley would enhance the ability to respond to runoff and curtail water deliveries that could aggravate local flooding. The design and construction of all conveyance facilities would follow standard engineering practices designed to avoid and minimize the risk of flooding. For example, a "cross-drainage study" would be conducted during the design phase of the Proposed Action to size facilities to withstand and handle flood events. A "supervisory monitoring system" would be installed during construction to allow computerized and "real-time" monitoring of stream levels affected by the Proposed Action. This system would automatically terminate supplemental flow releases into stream channels during periods of potential flooding.

Canals no longer needed to convey irrigation water after completion of the Proposed Action would not be altered. Maintenance of these canals for flood control purposes would be the responsibility of the irrigation companies that own them. Wasatch County has recently formed the WCSSA, which would be responsible for flood-control planning and reducing flood hazards by preserving existing flood control facilities in Heber Valley.

3.13.6.3.3 Potential Failure of Pipelines, Canals and Regulating Ponds. All gravity-pressure pipelines would be limited to 70 pounds per square inch (psi) or less. They would be buried with at least 3 feet of soil cover that would decrease the pressure of water if it escaped from the pipeline. Therefore, no health or safety hazards would be associated with gravity-pressure lines. The pumped pipeline laterals would have higher pressures in some cases, but the pumping stations would be equipped with a safety feature that automatically shuts down the station if it detects a rapid change in pressure associated with a break. The greatest pressure in any of the pipelines associated with the Proposed Action would be 115 psi in a 14-inch-diameter pipeline serving the Center Creek Irrigation Company.

Existing canals would be investigated to determine where embankments must be modified to increase freeboard to a minimum of 1 foot or stabilized where they are structurally weak. Cleaning the canals of brush and other debris would reduce the potential for canal and culvert blockages. As stated in Chapter 1, about 2 miles of Timpanogos Canal embankment would be lined on the downslope inside the canal to improve safety and increase freeboard. Freeboard would be increased in the Wasatch Canal by reducing the maximum flow rate in the canal because of reduced conveyance needs compared to baseline flow rates. A cross-drainage study would be performed before the project is designed to determine where spillways would be constructed along the canals. Spillways would discharge water into natural drainages or flood channels during emergencies to prevent water from overflowing canal embankments or otherwise spilling at undesired locations. Rehabilitation of existing canals would decrease or have no impact on the risk of flooding, depending on location in the valley.

Two new 2-acre regulating ponds would be constructed and an existing regulating pond would be rehabilitated. All would be equipped with spillways sized to prevent water from reaching levels that could cause a risk of embankment failure. The spillways would discharge into natural drainages or into the existing canals downstream of the ponds. The outflow from the ponds would not exceed inflow at any time and, because the canal reaches below the ponds have the same capacity as the those conveying water into the ponds, all water spilled from the ponds could be contained in the canals and routed to the flood control channel or infiltrate the canal bottoms.

3.13.6.3.4 Other Hazards During Operation. Existing canals that would be used under the Proposed Action are the Timpanogos, Wasatch, Sagebrush and Spring Creek, and Humbug. The risk of accidents would decrease slightly but not significantly in all these canals. Maximum flows and depths would be equal to, or less than, present maximum flows and depths in all but the Humbug Canal, which would increase in depth about 6 inches (from 2.5 to 3 feet) after the Proposed Action is constructed. Flow velocities in the Humbug Canal also would increase slightly. The invert of the canal (elevation of the canal bottom) would be excavated to a uniform slope; obstacles would be removed or reconstructed; and the downslope embankment of the canal would be improved for safety.

The inside face of all of the canals used under the Proposed Action would be cleaned and reshaped to improve conveyance efficiency. Operational freeboard would be increased to at least 1 foot, thereby reducing the risk of spills and increasing maximum capacity for emergencies. To minimize the risk of accidents, new safety fencing and steel grates (screens placed in canals and at diversion points) would be placed in the most hazardous canal areas. These include diversions, siphon inlets and outlets, pumping station intakes, turnouts, road crossings and concrete walls where children might play. The amount of fencing under the Proposed Action would be greater than under baseline conditions.

The Proposed Action would decrease health and safety risks along the Wasatch and Sagebrush and Spring Creek canals. Flows in these canals would be lower than baseline conditions, and the canals would be rehabilitated to improve their flow efficiency and structural soundness. Although the Timpanogos Canal would be used at the same maximum capacity as present conditions, lining the inside of the canal in the most hazardous areas would decrease health and safety hazards. The first 2,000 feet of the Wasatch Canal and Sagebrush and Spring Creek Canal upstream from the Lake Creek crossing would be operated year-round to deliver instream flow water. Both of these are in unpopulated areas with relatively level terrain, and would not present significant safety risks associated with ice during the winter periods.

The Proposed Action would increase recreation-related traffic in Heber Valley and the upper Strawberry River basin as fishermen and other recreationists drive to the restored streams. This would cause a minor increase in the risk of traffic accidents.

Above-ground and below-ground power lines used to power the Proposed Action's pumping stations would be built in conformance with applicable safety codes but could cause minor health and safety risks after construction. However, the above-ground lines would mostly be near the top of tall power poles with insulators, and warning signs would be placed near burial lines.

3.13.6.3.5 Impact Summary. There would be increased risk of traffic accidents for motorists driving near construction traffic and when recreation-related traffic increases after construction. However, the SOPs included in the Proposed Action would adequately reduce the risk for workers and the general public during construction. The Proposed Action would decrease the risk of flooding in some areas of Heber Valley by improving existing canals, and would have no impact on the risk of flooding in other areas. None of these impacts would be significant.

3.13.6.4 Daniel Replacement Project With Pipeline Alternative

3.13.6.4.1 Construction Hazards. Construction hazards and related SOPs under this alternative are the same as described for the Proposed Action in Section 3.13.6.3.1.

3.13.6.4.2 Hazards Related to Flooding From Streams and Canals. No physical changes would be made to canals in Heber Valley under this alternative, but late-season flows would decrease as a result of a reduction in the available CUP supply.

3.13.6.4.3 Potential Failure of the Daniel Replacement Pipeline. The worst-case pipeline rupture scenario under this alternative would occur if the Daniel Replacement Pipeline was completely ruptured, with the pipeline cross-sectional area fully exposed. This unlikely scenario might occur under an extremely severe earthquake.

Under this scenario, the area of greatest potential hazard would be from near Coyote Lane (station 230) to near 600 South (station 400), a distance of 17,000 feet (see Map A-2 in pocket at back of EIS). This entire reach of pipeline would be located in an area that is rapidly being developed and annexed by Heber City. The Daniel Replacement Pipeline would be 3 feet in diameter through this reach with a capacity of 27 cfs. Maximum operating pressure in the pipeline would be about 110 psi near the crossing of Creamery Ditch northeast of Heber City.

Maximum static pressure (pressure when the water velocity in the pipeline is zero) would be approximately 130 psi at this location. The flow in the pipeline would increase to 72 cfs if a complete rupture occurred in this vicinity when the pipeline gate at the river diversion site was fully open. It is assumed that 15 minutes would pass between the time the rupture occurred and the time that an operator would begin to close an upstream shutoff valve or the river diversion gate. The flow at the point of rupture would decrease from 72 cfs to zero over a 5- to 10-minute period, allowing about 2 acre-feet of water to escape before the valve is fully closed (1 acre-foot is equivalent to 1 acre of land covered with water 1 foot deep). As much as 3.5 additional acre-feet would drain from the pipeline if the rupture occurred at the lowest point between shutoff valves, assuming a maximum 4-mile spacing between valves. The water would flow overland to the two local drainages, Lake Creek and Creamery Ditch, and continue to Spring Creek which flows to the Provo River. A complete rupture could inundate some basements in homes with low foundation levels, but serious human injury would be very unlikely. Since a complete rupture would be associated with a major earthquake, area homes also would be damaged.

More probable (but still unlikely) is a crack or partial separation of a pipe joint caused by structural failure or accidental impact from a piece of farm or construction machinery. In this case, a much smaller volume of water would be released. The area surrounding the pipe rupture area would become saturated until the pipe is dewatered, inspected and repaired.

3.13.6.4.4 Other Hazards During Operation. The DRP With Pipeline Alternative would increase recreation-related traffic in Heber Valley and the upper Strawberry River basin as fishermen and other recreationists drive to restored streams. This would cause a minor increase in the risk of traffic accidents.

3.13.6.4.5 Impact Summary. There would be increased risk of traffic accidents for motorists driving near construction traffic and when recreation-related traffic increases after construction. However, the SOPs included in this alternative would adequately reduce the risk for workers and the general public during construction. There also would be a slight increase in the risk of flooding for people living near the Daniel Replacement Pipeline, but only during the unlikely event of an unexpected failure. None of these impacts would be significant.

3.13.6.5 Daniel Replacement Project With Canal Alternative

3.13.6.5.1 Construction Hazards. Potential construction hazard impacts and related SOPs for this alternative are the same as described for the Proposed Action in Section 3.13.6.3.1.

3.13.6.5.2 Hazards Related to Flooding From Streams and Canals. Potential flood hazard impacts for this alternative are the same as described for the Proposed Action in Section 3.13.6.3.2.

3.13.6.5.3 Potential Failure of the Enlarged Timpanogos Canal. Enlargement of the Timpanogos Canal would increase the depth of flow in the canal by less than 1 foot. Lining and strengthening the canal embankment and adding spillways and improved water control structures would decrease the risk of flooding under operating conditions. Operational freeboard would be increased to a minimum of 1 foot at all locations in the enlarged canal. The flow in the enlarged canal would increase by 33 cfs along the northern reach and 27 cfs along the southern reach. An earthquake or massive landslide could rupture the canal, resulting in an increase in peak flow from the canal. However, improved management of the canal system by CUWCD would likely result in a faster response time to close the canal gate at the Provo River and improved routing to controlled spillways compared to present operating procedures. This would likely reduce the volume of water that would escape from the canal and lessen the area of inundation.

3.13.6.5.4 Other Hazards During Operation. Other potential hazards during operation of this alternative would be the same as described for the Proposed Action in Section 3.13.6.3.4.

3.13.6.5.5 Impact Summary. There may also be a slight increase in the risk of flooding for some people living near the enlarged Timpanogos Canal, but the risk would decrease for most local residents. Flooding only would occur during the unlikely event of an unexpected failure of the canal. None of these impacts would be significant. There would be increased risk of traffic accidents for motorists driving near construction traffic and when recreation-related traffic increases after construction. However, the SOPs included in this alternative would adequately reduce the risk for workers and the general public during construction.

3.13.6.6 No Action Alternative

The No Action Alternative would have no impacts on health and safety. Baseline health and safety conditions would continue as described in Section 3.13.5.

3.14 Noise

3.14.1 Introduction

The noise analysis addresses potential impacts of noise under the Proposed Action and alternatives. The methodology used to conduct the noise analysis is described in Appendix B, Section B.2.13. The following impact topics are addressed in the impact analysis:

- Noise from construction activities

- Noise during operation and maintenance, including noise impacts from recreation traffic generated by the Proposed Action and alternatives

3.14.2 Issues Eliminated From Further Analysis

None of the noise issues raised during scoping and defined in Section 3.14.3 have been eliminated from further analysis.

3.14.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the noise impact analysis:

- Would construction procedures and traffic increase noise levels in Heber Valley under the Proposed Action and alternatives?
- Would noise levels from recreation traffic and increased recreation use increase under the Proposed Action and alternatives?
- What effects would the pump stations have on noise levels in Heber Valley?

3.14.4 Description of Impact Area of Influence

The impact area of influence for the noise analysis includes areas in Heber Valley and upper Strawberry River basin where noise generated by the Proposed Action and alternatives would be heard. Noise sources would include pumping stations, roads used by construction and recreation traffic, and areas used to construct, operate and maintain the Proposed Action and alternatives.

3.14.5 Affected Environment (Baseline Conditions)

Noise is measured using the A-weighted decibel scale (dBA). Values on this scale represent the loudness of common sounds perceived by humans.

Quantified noise data were not available to help define baseline noise conditions in the impact area of influence. However, some general conclusions can be reached based on field visits and published noise studies (CEQ 1970, Urban Institute 1976). Heber Valley is generally a quiet valley, except for noise generated by traffic on roads, especially Highways 40 and 189. Highway traffic typically generates noise at about 70 dBA, with large trucks reaching 90 dBA. These ratings are at a distance of 50 feet, the standard reference distance used in noise studies. Noise from these sources is reduced as the distance from the source increases. For example, doubling the distance reduces dBA ratings by a factor of four, if there are no other mitigating factors such as trees, walls and other physical barriers.

Sensitive noise receptors in the impact area of influence are primarily in the central portion of Heber City, except for the Valley Hills subdivision and isolated residences on large lots in rural areas. The sensitive receptors in central Heber City include four schools, a hospital and nursing home. None of these are adjacent to Highways 40 and 189.

There are no sensitive noise receptors in the upper Strawberry River basin; however, recreationists who visit the area are sensitive to noise because they usually prefer a quiet environment.

3.14.6 Impact Analysis

3.14.6.1 Significance Criteria

Noise that would be generated by the Proposed Action and alternatives was considered significant if it would exceed baseline noise levels and acceptable levels defined in EPA's Noise Pollution Level index (EPA 1971). Noise levels are considered significant if activities near sensitive receptors would likely generate noise exceeding levels considered "normally unacceptable" (74 to 88 dBA) in the EPA index. Noise at this level is annoying, and if people are exposed to it for long periods, barriers need to be constructed to make the indoor environment tolerable. Noise levels above 88 dBA are considered "clearly unacceptable" in the EPA index. They are very annoying, can cause hearing damage to people exposed for 8 hours or more, and the cost of constructing barriers to make the indoor and outdoor environments tolerable would be prohibitive.

3.14.6.2 Potential Impacts Eliminated From Further Analysis

All of the noise issues identified during scoping were addressed in the impact analysis.

3.14.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

3.14.6.3.1 Noise Related to Construction Activities. Noise would be generated by vehicles and equipment used to modify canals, dig pipeline trenches, haul borrow material, and construct regulating ponds and pumping stations. Construction activities would require using such equipment as compactors, bulldozers, loaders, cranes, trenchers, excavators, motor graders, scrapers and various types of trucks. Typical noise levels of this equipment at 50 feet are defined in Table 1-8 in Section 1.8.2.3 of Chapter 1. The loudest types of equipment are compactors, bulldozers, loaders and trenchers (up to 96 dBA at 50 feet), and cranes, motor graders and scrapers (up to 95 dBA at 50 feet). Most of this equipment would be confined to construction sites, except for trucks used to haul borrow material on Highways 40 and 189 and the smaller roads near construction sites. These types of trucks usually generate noise levels of 70 to 92 dBA at 50 feet.

Some sensitive noise receptors would be near construction sites, i.e., portions of the Valley Hills subdivision and more isolated residences east and southeast of Heber City. Some houses in the Valley Hills subdivision would be adjacent to the rehabilitation of the Wasatch and Timpanogos canals and a pumping station near station number 24,800 (see Map A-1 in pocket at back of EIS). Other residences would be adjacent to the Daniel Replacement Pipeline, smaller distribution pipelines, the regulating ponds and the modified Wasatch/Humbug Canal. Some residents and pedestrians in and near the Valley Hills subdivision and the more isolated residents near construction sites would experience significant and adverse noise impacts during construction. Some noise levels would exceed the significance criteria (74 to 88 dBA) for people within about 50 feet of construction sites. The noise impacts only would occur during the day for approximately 8 to 10 hours a day, five days a week and for approximately one to three weeks until each segment of construction is completed.

Baseline noise levels along Highways 40 and 189 include noise from large trucks that typically generate about 70 to 90 dBA. None of the sensitive noise receptors in Heber City are adjacent to Highway 40 or 189, and the noise level from trucks hauling borrow material during construction would likely be the same as emitted by large trucks under baseline conditions. Although the frequency of truck noise on the highways would increase until the borrow hauling is completed, the noise levels would not be significant for sensitive receptors along highways.

Some of the hauling of borrow material would occur on smaller roads in Heber Valley. Significant noise impacts could occur on and near roads that are not used by large trucks under baseline conditions. Residents, drivers, pedestrians, bicyclists and joggers on and along these roads would experience significant noise impacts as haul trucks drive by.

Abandonment and removal of the DIC diversion facilities in the upper Strawberry River basin would cause adverse noise impacts on recreationists and any others within hearing distance of construction activities. Bulldozers and other equipment would cause significant noise impacts for recreationists or others within about 50 feet of construction activities. Most recreationists would likely avoid the area and seek a quiet place to fish or hike. Some minor noise impacts also would occur in Heber City during construction of the HCSS.

3.14.6.3.2 Noise During Operation and Maintenance. The 10 pumping stations included in the Proposed Action would generate some noise during operation, but not at significant levels because they would be enclosed in structures that would greatly muffle the noise.

O&M and recreation traffic would increase noise levels on and along roads that would be used by O&M staff and recreationists attracted to the upper Strawberry River. The level would likely be the same as traffic under baseline conditions (up to 70 dBA), which falls below the "unacceptable" level of 74 dBA and above. The frequency of noise impacts along the roads would increase as traffic increases, most notably from recreation traffic on the lightly-used secondary roads in the upper Strawberry River basin.

New recreationists would increase noise levels along the streams in the upper Strawberry River basin. A much smaller increase in noise from fishermen who receive permission to fish or hike on private land would occur along Heber Valley streams that receive target supplemental instream flows.

3.14.6.3.3 Impact Summary. The Proposed Action would generate noise levels that exceed the significance criterion for people within about 50 feet of construction sites. Some people would experience significant noise impacts during construction along smaller roads in the impact area of influence that are not traveled by large trucks under baseline conditions. Recreationists would generate noise along roads as they drive to the upper Strawberry River basin.

3.14.6.4 Daniel Replacement Project With Pipeline Alternative

3.14.6.4.1 Noise Related to Construction Activities. Construction of the Daniel Replacement Pipeline would cause significant and adverse noise impacts for some residents in Valley Hills subdivision and isolated residences along the pipeline route to the east and southeast of Heber City. The magnitude and duration of these impacts would be essentially the same as described in Section 3.14.6.3 for the Proposed Action. The trucks needed to haul borrow material during construction would cause adverse noise impacts for people along smaller Heber Valley roads that are not traveled by large trucks under baseline conditions. These noise levels would exceed the significance criterion. All of these impacts would be experienced by people within about 50 feet of construction activities and truck traffic.

3.14.6.4.2 Noise During Operation and Maintenance. The same noise impacts associated with the Proposed Action and described in Section 3.14.6.3 would occur under the DRP With Pipeline Alternative, with one exception. Noise impacts near pumping stations would occur in different and fewer places, since this alternative only has three pumping stations, all in the rural area southeast of Heber City (see Map A-2 in pocket at back of EIS).

3.14.6.4.3 Impact Summary. The impact summary in Section 3.14.6.3.3 also applies to the DRP With Pipeline Alternative.

3.14.6.5 Daniel Replacement Project With Canal Alternative

The DRP With Canal Alternative would cause the same noise impacts described in Section 3.14.6.4 for the DRP With Pipeline Alternative, except for impacts near pumping stations. The DRP With Canal Alternative would include two pumping stations in different locations than the three included in the DRP With Pipeline Alternative. Both stations would be in the rural area southeast of Heber City (see Map A-2 in pocket at back of EIS).

3.14.6.6 No Action Alternative

The No Action Alternative would not change noise levels or cause noise impacts, and baseline noise conditions would continue.

3.15 Visual Resources

3.15.1 Introduction

The visual analysis addresses potential impacts on visual resources from the construction of the Proposed Action and alternatives. The focus of the analysis is on potential visual impacts seen from three critical viewpoints: Highway 40 looking south over the Heber Valley, Valley Hills Subdivision and Memorial Hill. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.2.14. The following visual impact topics are addressed in the impact analysis:

- Views from critical viewpoints focusing on middle-ground and background views
- Changes in existing landscape character attributes

3.15.2 Issues Eliminated From Further Analysis

None of the visual issues raised during scoping and listed in Section 3.15.3 have been eliminated from further analysis.

3.15.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What visual impacts would occur from pump stations and related power lines?
- How would these impacts be mitigated?
- How would restoration of instream flows to Heber Valley tributary streams affect visual resources?
- What impacts would pipeline right-of-ways have on visual resources?
- What other types of visual impacts would occur?

3.15.4 Description of Impact Area of Influence

The impact area of influence for evaluating impacts on visual resources is Heber Valley, upper Strawberry River basin and the Daniels Creek corridor. Visual impacts also would occur in areas with fewer viewers, where the facilities would be constructed and roads traveled by construction vehicles.

3.15.5 Affected Environment (Baseline Conditions)

Existing conditions related to visual resources were used as baseline for the impact analysis. Heber Valley is visually characterized as a picturesque, relatively flat, broad valley dominated by green agricultural fields, with Jordanelle and Deer Creek reservoirs forming the northern and southern boundaries, respectively. The spectacular Wasatch Mountains, including Mt. Timpanogos, are viewed in the background on the west side of the valley from the three critical viewpoints. The valley's east side is framed by sloping hills. The Wasatch and Timpanogos canals run along the east side of the Heber Valley. The canal structures are not directly visible from the critical viewpoints, but the alignments can be identified by the riparian vegetation that grows along the canal banks. The Provo River bisects the valley, running between Jordanelle and Deer Creek reservoirs. The river is easy to identify visually because of the distinct riparian woodland vegetation growing along the river banks. The valley is primarily an agricultural area with much open space, but also is home to residents of small, fast-growing communities, including Heber City, Midway, Daniels, Casperville and Charleston.

Daniels Creek is confined to a narrow, V-shaped canyon. The stream corridor is not visible from the three critical viewpoints. Highway 40 runs adjacent to the stream throughout much of the stream corridor between Heber City and the upper Strawberry River basin, where the stream is somewhat visible from a car traveling at low speed.

The project's visual impacts would be experienced by people who live and work near project facilities, travel Highway 40 and other valley roads near project facilities, and travel along Daniels Creek.

The upper Strawberry River basin is characterized as a high-elevation valley surrounded by rolling hills. Highway 40 bisects the impact area of influence in the upper Strawberry River basin. Most of the basin is comprised of undeveloped land managed by the USFS.

3.15.6 Impact Analysis

3.15.6.1 Significance Criteria

Established visual quality objectives or scenic standards could not be used as significance criteria in this analysis because they do not exist in Wasatch County. Therefore, the visual impacts of the Proposed Action and alternatives are considered adverse and significant if they would be in contrast with baseline landscape attributes, long-term, and seen in the middle-ground or background-distance zones from the critical viewpoints. Visual impacts were considered long-term if affected landscape attributes would not be restored to pre-project conditions within 2 years after completion of project construction.

3.15.6.2 Potential Impacts Eliminated From Further Analysis

Some potential impacts on visual resources have been eliminated from further analysis because the SOPs listed in Section 1.12.9 of Chapter 1 would restore visual resources to preconstruction conditions. These are presented for the Proposed Action and alternatives in the following paragraphs.

There would be no significant changes in visual resources from the restoration of instream flows to Heber Valley tributary streams because no changes are expected in grazing practices and vegetation.

There also would be no significant changes in visual resources from construction of the pipeline or canal improvements under the Proposed Action and alternatives. Many pipeline and canal construction activities would be at or below ground level, and SOPs are expected to limit the amount of tree clearing and removal of other vegetation. The SOPs would lead to the successful recontouring, revegetation and visual restoration of most disturbed areas (pipeline ROWs, accessways and along enlarged and rehabilitated canals). Vegetation would be restored to preconstruction conditions in two to three full growing seasons.

3.15.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following subsections describe potential visual impacts during and after construction of the Proposed Action. These impacts would not be visible from the three critical viewpoints.

3.15.6.3.1 Visual Impacts During Construction. Adverse visual impacts would occur as the Proposed Action is constructed. Cranes, bulldozers and other equipment would be used to construct the project. Visual changes and contrasts in color, texture and line would occur along canals that are enlarged and rehabilitated (i.e., Wasatch and Timpanogos canals), where power poles, power lines, pumping stations and WCWEP pipelines are installed, and in areas where road crossings are necessary. Affected viewers would include residents near construction activities, people driving near construction zones and at road crossings.

About 263.6 acres of existing vegetation would be disturbed during construction activities under the Proposed Action, causing contrasts in color and texture. Table 1-15 in Section 1.12.3.1 of Chapter 1 presents impacted acreage by land use category. Visual impacts during construction would not be significant because they would be limited to the period of construction.

Temporary visual impacts would occur in the upper Strawberry River basin from construction activities related to eliminating the DIC diversion facilities. The impacts would include equipment causing dust, emissions and some color and texture changes between barren soil and existing vegetation until new vegetation is established. These impacts would not be significant.

3.15.6.3.2 Visual Impacts After Construction. About 11.5 acres of land would be disturbed by the Proposed Action and not reclaimed. Most of this area would consist of pumping stations, canal O&M roads and regulating ponds. The canal O&M roads would be constructed on the embankment of existing canals, causing no new contrast with the existing landscape. Regulating ponds and pump station buildings would be a new features on the landscape. Pump station buildings would be painted to blend with the surrounding landscape. No significant impacts would result from construction of these facilities.

Under the Proposed Action 3.6 miles of powerline would be extended to supply power for pump stations. The pump stations, power poles (most of them 30 feet tall) and power lines would be above-ground, permanent facilities. Figure 1-7 in Section 1.8.4.1 of Chapter 1 shows these facilities. In a few of the open, agricultural or undeveloped areas of Heber Valley, these facilities would be out of character with the existing landscape and would cause adverse visual impacts by introducing vertical lines and form into the landscape. Viewers that would experience these line and structural element introductions would be those who live or work near these facilities or could see them from local roads. Since none of these facilities would be seen from the three critical viewpoints, they would not cause significant and adverse impacts.

The Proposed Action would reduce flows in upper Daniels Creek. This would be an adverse change in the visual character of the stream by exposing more bank to some, but not all, recreationists who visit Daniels Creek. Some who visit Daniels Creek would not experience adverse visual impacts since there would still be a year-round flow in the stream after the project is implemented. The magnitude of the flow change would vary among viewers and is very subjective. Many visitors to Daniels Creek would not notice a reduction in flow unless they were familiar with existing flows in the stream and were consciously comparing flows before and after the project. The decreased flow of Daniels Creek would be not be detectable from the three critical viewpoints, so the adverse visual impacts along Daniels Creek would not be significant.

Elimination of diversion facilities in the upper Strawberry River basin would restore 4.3 acres of existing man-made reservoirs to wetlands by breaching existing dams at Daniel reservoirs No. 1 and No. 3. Restoration and enhancement of 70.4 acres of wet meadow would enhance the visual landscape. Changes in the existing landscape would include color, texture and landform changes from converting the reservoirs to wetland meadow. Existing canals and roads would be abandoned and restored to match adjacent contours, and revegetated to blend with the surrounding areas. Headcuts at Bjorkman Hollow and McGuire Hollow would be reshaped and revegetated to blend with surrounding lands. These areas are viewed by a limited number of viewers, but restoration of these features would improve visual quality and return the areas to more natural-looking landscape conditions.

3.15.6.3.3 Impact Summary. A total of 263.6 acres in Heber Valley would be temporarily disturbed during construction of the Proposed Action, causing short-term adverse visual impacts. These disturbed areas would be restored as part of the SOPs described in Section 1.12.9 of Chapter 1. About 11.5 acres would be permanently changed from existing agricultural and natural landscape to project features, including O&M roads, regulating ponds and pumping stations. About 3.6 miles of above-ground powerline with 30-foot poles would be extended to supply power for pump stations. These minor visual changes are not considered significant because they would not be out of character with the existing landscape or a major concern to viewers. The scenic character of impact area of influences in the upper Strawberry River basin would be improved by reclaiming man-made features to a more natural-looking landscape.

3.15.6.4 Daniel Replacement Project With Pipeline Alternative

The following subsections describe potential visual impacts during and after construction of the DRP With Pipeline Alternative. These impacts would not be visible from the three critical viewpoints.

3.15.6.4.1 Visual Impacts During Construction. Adverse changes to the color and texture in the landscape would occur during construction of the DRP With Pipeline Alternative. Cranes, bulldozers and other equipment would be used to construct the project. Visual changes in color and texture would be similar to those described under the Proposed Action in Section 3.15.6.3.1.

About 95.3 acres in the Heber Valley would be disturbed during construction and until vegetation is re-established from construction activities under the DRP With Pipeline Alternative. Table 1-16 in Section 1.12.3.1 of Chapter 1 lists impacted acres by land-use category.

3.15.6.4.2 Visual Impacts After Construction. Construction of pumping stations under the DRP With Pipeline Alternative would disturb about 0.3 acres of land that would not be reclaimed. A total of 0.7 mile of powerline would be extended to supply power for pump stations. The power poles (most of them 30 feet tall) and power lines would be above-ground, permanent facilities (see Figure 1-7 in Chapter 1, Section 1.8.4.1). Impacts from installing these facilities would be the same as those described for the Proposed Action in Section 3.15.6.3.2.

Pump station buildings would be a new feature on the landscape. These are not expected to be unsightly, so the visual impact is not significant. Pump station buildings would be painted to blend with the surrounding landscape.

The DRP With Pipeline Alternative would reduce flows in upper Daniels Creek. Impacts would be the same as described under the Proposed Action In Section 3.15.6.3.2.

Visual changes from restoration activities in the upper Strawberry River basin would be the same as described under the Proposed Action in Section 3.15.6.3.2.

3.15.6.4.3 Impact Summary. A total of 95.3 acres in Heber Valley would be temporarily disturbed during construction of the DRP With Pipeline Alternative, causing short-term adverse visual impacts. About 0.3 acres would be changed from existing agricultural and natural landscape to pumping stations. A total of 0.7 mile of above-ground powerline with 3-foot poles would be extended to supply power for pump stations. These minor visual changes are not considered significant because they are not out of character with the existing landscape or of major concern to viewers. Visual improvements in color, texture and landform would result from abandonment and removal of DIC diversion facilities in the upper Strawberry River basin.

3.15.6.5 Daniel Replacement Project With Canal Alternative

The following subsections describe potential visual impacts during and after construction of the DRP With Canal Alternative. These impacts would not be visible from the three critical viewpoints.

3.15.6.5.1 Visual Impacts During Construction. Adverse visual impacts would occur during construction of this alternative. Cranes, bulldozers and other equipment would be used to construct the project. Visual impacts would be similar to those described for the Proposed Action in Section 3.15.6.3.1.

About 78.9 acres in the Heber Valley would be disturbed in the short-term from construction activities under this alternative. Table 1-17 in Section 1.12.3.1 of Chapter 1 lists impacted acres by land-use category.

3.15.6.5.2 Visual Impacts After Construction. Construction of pumping stations and canal O&M roads under this alternative would disturb about 5.1 acres of land that would not be reclaimed.

Impacts of powerline extensions and pump stations would be the same as those described for the Proposed Action in Section 3.15.6.3.2.

Under the DRP with Canal Alternative, 1 mile of powerline would be extended to supply power for pump stations. The pump stations, power poles (most of them 30 feet tall) and power lines would be above-ground, permanent facilities. Figure 1-7 in Chapter 1, Section 1.8.4.1 shows these facilities. Impacts from installation of these facilities would be the same as those described under the Proposed Action in Section 3.15.6.3.2.

The DRP With Canal Alternative would reduce flows in upper Daniels Creek. Impacts would be the same as described under the Proposed Action in Section 3.15.6.3.2.

Visual changes from restoration activities in the upper Strawberry River basin would be the same as described under the Proposed Action in Section 3.15.6.3.2.

3.15.6.5.3 Impact Summary. A total of 78.9 acres in the Heber Valley would be temporarily disturbed during construction of the DRP With Canal Alternative, causing short-term adverse visual impacts. About 5.1 acres would be changed from existing agricultural and natural landscape to project features, including O&M roads and pumping stations. These minor visual changes are not considered significant because they are not out of character with the existing landscape or of major concern to viewers. The scenic character of impact area of influences in the upper Strawberry River basin would be improved by reclaiming man-made features to a more natural-looking landscape. A total of 1 mile of above-ground powerline with 30-foot poles would be extended to supply power for pump stations.

3.15.6.6 No Action Alternative

The No Action Alternative would have no impacts on visual resources. The baseline visual characteristics described in Section 3.15.5 would continue under the No Action Alternative.

3.16 Recreation Resources

3.16.1 Introduction

The recreation analysis addresses potential impacts on recreation from the construction, operation and management of the Proposed Action and alternatives. The focus of the analysis is on increases and decreases in the number of angler days related to aquatic habitat and fish standing crop. The assumptions and impact topic analysis methods used to conduct the recreation analysis are defined in Appendix B, Section B.2.15. The following recreation impact topics are addressed in the impact analysis:

- Changes in the quantity of recreation use (angler days)
- Physical impacts on existing and proposed recreation areas
- Impacts on the quality of recreation at existing and proposed areas

3.16.2 Issues Eliminated From Further Analysis

None of the recreation issues raised during scoping and defined in Section 3.16.3 have been eliminated from further analysis.

3.16.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What impacts would occur on private land from recreational fishing access?
- What would be the potential effects on establishment of local fisheries if instream flows are restored to Heber Valley tributary streams, and would the streams be easily accessible by seniors and children?
- What impacts would the influx of new recreationists into Heber Valley have on existing recreation?
- How would recreation access and fishing policies affect existing recreation in Heber Valley?
- What non-fishing recreational impacts would occur from construction and operation of the WCWEP and DRP?
- How would elimination of the transbasin diversion affect recreational fishing and other recreational activities in upper Daniels Creek (reduction of flows)?
- Could an adequate recreational fishery be maintained in Daniels Canyon without the transbasin diversion from the Strawberry River basin?

3.16.4 Description of Impact Area of Influence

The recreation impact area of influence includes the streams in the Heber Valley that would receive supplemental instream flow under the Proposed Action (i.e., Spring Creek, Rock Ditch, lower Lake Creek, London Ditch and Creamery Ditch), Daniels Creek and existing and proposed recreation areas in and around Heber Valley. These areas include Wasatch Mountain State Park and recreation facilities at Jordanelle and Deer Creek reservoirs. The recreation impact area of influence also includes the upper Strawberry River basin.

3.16.5 Affected Environment (Baseline Conditions)

Baseline is the same as existing conditions for the recreation impact analysis. Anglers fish in Heber Valley streams throughout the fishing season, gaining access through fences and private roads with and without permission of landowners. The number of angler days spent on Heber Valley streams is unknown.

Daniels Creek is heavily fished during the open fishing season, with access along Highway 40. Fishing pressure is highest during June and July, tapering off in August. Utah Division of Wildlife Resources stocks fish in Daniels Creek around the major spring and summer holidays such as Memorial Day, Independence Day and Labor Day. A creel census conducted by Utah Division of Wildlife Resources in 1989 documents a total catch rate of one fish per hour for Daniels Creek. The average number of fisherman per census count during all weekdays ranged from zero to five (Sakaguchi 1994).

The upper Strawberry River basin and tributaries have been closed to fishing. As of January 1, 1996, those streams are open for catch-and-release fishing with lures and flies only.

3.16.6 Impact Analysis

3.16.6.1 Significance Criteria

The following types of impacts on recreation would be considered significant:

- A net reduction or elimination of recreation opportunities
- Physical damage to recreation facilities
- Physical damage to roads or trails that access recreation areas

- A net increase in recreation opportunities

- Potential impacts on the quality of recreation opportunities and uses are considered significant and adverse if the public's expectation for a quality recreation experience would be diminished.

3.16.6.2 Potential Impacts Eliminated From Further Analysis

The following potential impacts were eliminated from further analysis:

- Would the streams receiving supplemental instream flows be easily accessible by seniors and children?

  No access would be provided to Heber Valley streams for seniors and children under the Proposed Action and alternatives.

- What impacts would the influx of new recreationists into Heber Valley have on existing Recreation?

- How would recreation access and fishing policies affect existing recreation in Heber Valley?

  Existing recreation in Heber Valley would not change from baseline conditions under the Proposed Action and alternatives.

3.16.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following sections define potential recreation impacts during construction and operation of the Proposed Action.

3.16.6.3.1 Impacts on Recreation Use. The Proposed Action would improve trout habitat and increase trout biomass by 244 percent over baseline in Rock Ditch, Spring Creek, Creamery Ditch, London Ditch and lower Lake Creek. The potential increase in the number of angler days actually realized would not be significant because public access would not be provided along the streams. Anglers would need to receive permission from local land owners.

Eliminating upper Strawberry River basin flows from Daniels Creek would not change recreation use because the Utah Division of Wildlife Resources would continue to stock about 7,500 fish over the summer months, which would support about 1,330 angler days.

The restoration of natural stream flows in the upper Strawberry River basin under the Proposed Action would make possible the replacement of 10,000 angler days to help mitigate losses attributed to the Strawberry Aqueduct and Collection System.

Restoration of historic flows in the upper Strawberry River and its tributaries would substantially reduce the need to stock fish in the Strawberry Reservoir. Therefore, that hatchery production previously stocked in Strawberry Reservoir would be reallocated to other waters, resulting in an increase of 201,946 angler days outside of the Strawberry Valley. Analyzed benefits to Strawberry Reservoir water released to the Strawberry River or other Uinta basin streams affected by the Strawberry Aqueduct and Collection System would supplement current instream flows and create 1,914 additional angler days (FWS 1996). Section 303(b)(1)(c) of the CUPCA identifies the Mitigation Commission as responsible for determining how to regulate flows returned to Strawberry Reservoir from the terminated DIC transbasin diversion.

3.16.6.3.2 Physical Impacts on Recreation Areas. The Proposed Action would not result in any physical impacts on existing developed recreation areas. Beneficial physical impacts would occur on Heber Valley streams from the increased instream flows under the Proposed Action, including enhanced habitat to support wild fishery development and production in the Heber Valley streams. There also is a potential for enhanced riparian habitat immediately along the stream corridor, depending on future livestock grazing practices. There is potential for trespassing and vandalism by anglers on private land along the five Heber Valley streams that would receive supplemental instream flows.

Flows in Daniels Creek would continue to be sufficient to support a stocked recreational fishery. Return of flows to the upper Strawberry River basin would increase fish production and provide additional recreation angler days.

3.16.6.3.3 Impacts on Recreation Quality. Recreation quality would improve in the upper Strawberry River basin from the return of natural flows that would support 10,000 angler days.

3.16.6.3.4 Impact Summary. The Heber Valley streams that would receive supplemental water under the Proposed Action have the potential to provide 1,199 additional angler days from an increase in fish production (based on an increase in trout biomass see Section B.3.15.2.1 of Appendix B for calculation method). This recreation opportunity depends on the ability to obtain permission to fish the the streams from private landowners because access would not be provided under the Proposed Action. Trepassing by anglers on private lands could occur.

There would be no change in recreation use on Daniels Creek because the Utah Division of Wildlife Resources would continue to stock the stream as a put-and-take fishery.

The restoration of natural stream flows in the upper Strawberry River basin under the Proposed Action would make possible the replacement of 10,000 angler days to help mitigate losses attributed to the Strawberry Aqueduct and Collection System. Angler days would increase by 201,946 outside the Strawberry River Valley as described in Section 3.16.6.3.1. An additional 1,913 angler days would be gained in the Strawberry River and other Uinta basin streams as described in Section 3.16.6.3.1.

3.16.6.4 Daniel Replacement Project With Pipeline Alternative

The following sections describe potential recreation impacts under the DRP With Pipeline Alternative.

3.16.6.4.1 Impacts on Recreation Use. Recreation use on Daniels Creek and in the upper Strawberry River basin would be the same as described in Section 3.16.6.3.1 for the Proposed Action.

3.16.6.4.2 Physical Impacts on Recreation Areas. Physical impacts on recreation areas along Daniels Creek and the upper Strawberry River basin would be the same as described in Section 3.16.6.3.2 for the Proposed Action.

3.16.6.4.3 Impacts on Recreation Quality. Recreation quality on Daniels Creek and in the upper Strawberry River basin would be the same as described in Section 3.16.6.3.3 for the Proposed Action.

3.16.6.4.4 Impact Summary. There would be no change in recreation use on Daniels Creek because Utah Division of Wildlife Resources would continue to stock the stream as a put-and-take fishery.

Angler days would increase by 201,946 outside the Strawberry River Valley as described in Section 3.16.6.3.1. An additional 1,913 angler days would be gained in the Strawberry River and other Uinta basin streams as described in Section 3.16.6.3.1.

3.16.6.5 Daniel Replacement Project With Canal Alternative

Changes in recreation under the DRP With Canal Alternative would be the same as described in Section 3.16.6.4 for the DRP With Pipeline Alternative.

3.17 Cultural and Paleontological Resources

3.17.1 Introduction

The cultural and paleontological resources analysis addresses potential impacts on these resources from the construction, operation and maintenance of the Proposed Action and alternatives. The information and analysis documented in this section was summarized from the Draft Cultural Resources Technical Report (CUWCD 1996b), which is available from CUWCD upon request. The assumptions and impact topic analysis methods used to conduct the cultural resources analysis are define din Appendix B, Section B.2.16. The following topics are addressed in the impact analysis:

- Cultural resources
- Paleontological resources

3.17.2 Issues Eliminated From Further Analysis

Issues eliminated from further analysis include the proposed changes in flows for the following canals, ditches and streams: Sagebrush and Spring Creek Canal, Upper and Lower Charleston canals, the Main, Upper and Lower Extension, London Ditch, Creamery Ditch, Rock Ditch, Spring Creek, and lower Lake Creek. The changes in flows would have no impacts on cultural and paleontological resources.

3.17.3 Issues Addressed in the Impact Analysis

Issued addressed cover prehistoric, historic, ethnographic and paleontological resources. The following issues were raised during scoping and are addressed in the impact analysis:

- How would historically significant canals be affected, including rehabilitation, abandonment, modifications to diversion structures and other alternations to historic resources?
- What would be the impacts of constructing pumping stations, access roads and staging areas?
- What would be the impacts of constructing pipelines and powerlines?

3.17.4 Description of Impact Area of Influence

The cultural and paleontological resources impact area of influence consists of all areas of construction in Heber Valley and the upper Strawberry River basin under the Proposed Action and alternatives. The Heber Valley part of the impact area of influence includes the area between the Jordanelle Dam and Deer Creek Reservoir, bounded on the east by the Timpanogos Canal and on the west by the Provo River. The upper Strawberry River basin part of the impact area of influence was analyzed for impacts from abandonment and removal of the historic Strawberry River diversion structures and canals.

3.17.5 Affected Environment (Baseline Conditions)

No prehistoric sites or paleontological localities have been recorded within the impact area of influence. Existing literature studies indicate that seven historic archaeological sites and numerous historic standing structures were previously recorded in the current impact area of influence. The seven historic sites consists of the Heber Light and Power Company plant, which was largely destroyed in 1988, the Timpanogos diversion dam and associated canals, a milk barn foundation, the Mayflower Mine complex, the Tate dairy farm and homestead, the Mahoney homestead and the Utah Valley Railroad. There are so many more historic standing structures in Heber Valley, that they are not listed in this section. Only a small portion of the impact area of influence has been surveyed, so these sites may not accurately represent additional sites that may be located in the impact area of influence.

3.17.6 Impact Analysis

3.17.6.1 Significance Criteria

3.17.6.1.1 Cultural Resources Significance Criteria. Impacts are considered significant if they result in adverse effects on known sites that are deemed eligible for or are already listed on the National Register of Historic Places (NRHP). The rationale for this significance criterion is based on the federal legislation discussed below.

Eligibility for the NRHP is determined by criteria included in federal implementing regulation 36 CFR 60.4, which states that consideration is given to "districts, sites, buildings, structures and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association, and; (A) that are associated with events that have made a significant contribution to the broad patterns of our history; or (B) that are associated with the lives of persons significant in our past; or (C) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or (D) that have yielded, or may be likely to yield, information important in prehistory or history."

Federal implementing regulation 36 CFR 800 states that cultural resource assessments of federal "undertakings" of eligible properties should result in one of three determinations:

- No effect
- No adverse effect, i.e., one or more historic properties will be affected but the historic qualities that make them significant will not be harmed
- Adverse effect, i.e., the undertaking will cause harm to one or more historic properties.

3.17.6.1.2 Paleontological Significance Criteria. Impacts will be considered significant if they result in adverse effects on Type 1 or 2 paleontologically sensitive geological formations or in adverse effects on Class 1, 2, or 3 paleontologically sensitive fossil localities. The definitions and rationale for these criteria is discussed below.

Paleontological research and the determination of significant effects are guided, in part, by a geologic formation classification system and a sensitivity classification of fossil localities, both suggested by the Bureau of Land Management (BLM) and modified from National Academy of Sciences (NAS) Committee on Guidelines for Paleontological Collecting (NAS 1987). It also is guided by a priority fossil list entitled Paleontologically Sensitive Formations in Utah by Jim Madsen (undated), former State Paleontologist for the state of Utah.

Following is a description of the classification system for defining the paleontological sensitivity of geological formations:

- Type 1: Formations known to contain fossils of significant scientific interest, or where significant fossils (especially vertebrates) are likely to be discovered with detailed field work
- Type 2: Formations where fossils are present, but by their nature are not anticipated to be of high scientific value (but are still considered to be important)
- Type 3: Formations containing few fossils or those found are of little scientific value

Following is a description of the classification system for defining the paleontological sensitivity of fossil localities:

- Class 1: Critical — reference locality for holotype or critical paleontological material, or any type section of geological strata needed for future study. All vertebrate fossil sites fall within this category.
- Class 2: Significant — any locality that produces rare, well-preserved, or critical fossils usable for taxonomic, evolutionary, stratigraphic, paleoenvironmental, or paleoecological studies
- Class 3: Important — any locality that produces common, abundant fossils useful for stratigraphic or population variability studies
- Class 4: Insignificant — any locality with poorly preserved, common, or stratigraphically unimportant fossil material
- Class 5: Unimportant — any locality intensively surveyed and determined to be of minimal scientific interest

3.17.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential cultural resources impacts have been eliminated from further analysis.

3.17.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following subsections define potential impacts on cultural resources during the construction and operation of the Proposed Action. The subsections are divided into potential impacts on cultural resources in Heber Valley that would be affected by the Proposed Action and known impacts from abandonment and removal of DIC diversion facilities in the upper Strawberry River basin. Since only a sample survey was completed in the Heber Valley portion of the impact area of influence that would be affected by the Proposed Action, impacts on cultural resources are discussed in terms of their potential. Impacts on cultural resources in the upper Strawberry River basin are known because a survey of 100 percent of the DIC diversion facilities was completed in 1995.

3.17.6.3.1 Heber Valley. No known cultural resources would be adversely affected by the Proposed Action, but it is likely that historic farmsteads, sheds, fences and other historic features, which have not yet been recorded, could be adversely Affected. No known paleontological resources would be adversely affected by the Proposed Action; however, paleontological surveys have not been completed and potential effects of construction on the resources is not known.

3.17.6.3.2 Upper Strawberry River Basin. The DIC diversion facilities, located in the upper Strawberry River basin, were fully recorded and determined eligible for the NRHP under Criteria A and C (see Section 3.17.6.1). Map 3-1 in Section 3.1.1 and Map 1-4 in Chapter 1, Section 1.8.7 show the locations of DIC diversion facilities in the upper Strawberry River basin. The following proposed construction activities would have no adverse effect on the individual features of the NRHP eligible portion of the DIC diversion facilities:

- The siphon pipe would be plugged with concrete.
- Each end of the tunnel would be plugged with concrete.
- The Bjorkman Hollow and McGuire Hollow headcuts would be reshaped and revegetated.
- The dams at Daniel reservoirs No. 1 and No. 3 would be breached and stabilized to create 4.3 acres of wetlands upstream of the dams.
- The Strawberry River diversion structure would be modified to provide fish passage.
- Twelve concrete diversion structures would be removed and the surrounding canal areas would be recontoured to match natural sloped and revegetated.
- All roads associated with the diversion facilities would be closed and revegetated.
- Canals would be stabilized where they cross natural drainages by removing canal banks and filling, recontouring and revegetating the cutoff canal ends.
- Three stream gauges would be removed and the disturbed areas revegetated.
- A pipeline would be installed in part of the canal system to convey water to watering troughs for wildlife and livestock.

The combination of no adverse effects of the Proposed Action on these features of the DIC diversion facilities would be an overall adverse effect because it would destroy much of the canal system and compromise the integrity of the historic property. This overall adverse effect would be a significant impact on cultural resources.

3.17.6.3.3 Impact Summary. The Proposed Action would have an overall adverse impact on cultural resources in the upper Strawberry River basin. The integrity of historic property would be compromised by removal of features of the DIC diversion facilities, resulting in a significant impact on cultural resources.

3.17.6.4 Daniel Replacement Project With Pipeline Alternative

The impacts of this alternative would be the same as described for the Proposed Action in Section 3.17.6.3.

3.17.6.5 Daniel Replacement Project With Canal Alternative

The impacts of this alternative would be the same as described for the Proposed Action in Section 3.17.6.3.

3.17.6.6 No Action Alternative

The No Action Alternative would have no impact on cultural and paleontological resources. Baseline conditions would continue as described in Section 3.17.5.

3.18 Transportation

3.18.1 Introduction

The transportation analysis addresses potential impacts on transportation systems from the construction, operation and maintenance of the Proposed Action and alternatives. The focus of the analysis is on potential traffic impacts during construction. The assumptions and impact topic analysis methods used to conduct the transportation analysis are defined in Appendix B, Section B.2.17. The following transportation impact topics are addressed in the impact analysis:

- Transportation impacts during construction (changes in traffic and physical impacts on roads)
- Transportation impacts during operation (changes in traffic)

3.18.2 Issues Eliminated From Further Analysis

None of the transportation issues raised during scoping and defined in Section 3.18.4 have been eliminated from further analysis.

3.18.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What would be the impact of the pending Highway 189 upgrade through Provo Canyon in combination with the Proposed Action and alternatives?
- What traffic impacts would the Proposed Action and alternatives have on roads and transportation systems during construction?
- What impact would increased recreational use of Heber Valley streams have on transportation systems?
- What physical impacts would occur on local roads from heavy equipment and other project construction traffic?

3.18.4 Description of Impact Area of Influence

The transportation impact area of influence consists of roads that would be used during construction, operation and maintenance of the Proposed Action and alternatives. Additional impacts would occur during construction on roads that are crossed by pipelines included in the Proposed Action and alternatives. The specific roads included in the impact area of influence are shown on Map A-1 (in pocket at back of EIS) and are identified in Section 3.18.5.

3.18.5 Affected Environment (Baseline Conditions)

The Heber Valley road system consists of three primary roads, federal Highways 40 and 189 and state Highway 113. Highways 40 and 189 would be the primary travel routes for construction workers and vehicles. Other local roads that would be affected include Highway 113, Center Street, Lake Creek Road, 1200 South, 1200 East, Mill Road, 2400 East and Dukes Lane.

Baseline traffic conditions are traffic levels that would exist during construction around the year 2000. Those levels are 10,550 Annual Average Daily Traffic (AADT) on Highway 40 and 6,167 AADT on Highway 189. Baseline traffic levels are based on data provided by UDOT (UDOT 1992). Peak traffic would occur when many Heber Valley residents commute to Provo, Orem, Park City or Salt Lake City. Traffic data are not available for the other roads that would be affected in the impact area of influence, however construction traffic on these roads would be more dispersed and lighter than on Highways 40 and 189.

3.18.6 Impact Analysis

3.18.6.1 Significance Criteria

The transportation significance criteria are based on federal and state regulations and standards, professional judgment and contacts with state and county officials. The following types of impacts on transportation systems would be considered significant:

- Travel delays of more than 10 minutes at any one time
- Physical damage to roads that is not repaired to a level equal to or better than the condition of the affected roads before construction of the Proposed Action and alternatives

3.18.6.2 Potential Impacts Eliminated From Further Analysis

Potential physical impacts to roads from construction vehicles were eliminated from further analysis because the SOPs include a commitment to repair all damage caused by the Proposed Action and alternatives during construction.

3.18.6.3 Proposed Action (WCWEP With Daniel Replacement Pipeline)

The following sections define potential transportation impacts during construction and operation of the Proposed Action. Construction of the Proposed Action would cause the following types of transportation impacts:

- Increases in traffic on local roads as construction workers commute to and from Proposed Action construction sites
- Increases in traffic on local roads as gravel and pipe material is hauled to Proposed Action construction sites and other construction vehicles are used during construction
- Physical impacts on roads where Proposed Action pipelines would cross Heber Valley roads

3.18.6.3.1 Traffic Increases During Construction. Most construction traffic related to the Proposed Action would be dispersed throughout the impact area of influence during the two snow-free periods of the construction schedule (usually from March to November), but concentrated near the two construction yards and on Highways 40 and 189. The location of these yards has not been determined, but they probably would be near Highway 40 and possibly near Highway 189. Construction workers from the Salt Lake City and Provo/Orem areas would commute on Highway 40 north of Heber City during construction north and northeast of Heber City. This same stretch of road would be used by trucks to haul pipe and borrow material to construction sites. The Highway 40 segment southeast of Heber City would receive most of the traffic when construction of the Proposed Action is east to southeast of Heber City. Workers from the Provo/Orem area and trucks hauling borrow material would use Highway 189. Workers from the Salt Lake City area and trucks hauling pipe material probably would travel on Highway 189 for relatively short periods when construction is in areas west to southwest of Heber City. Heavy construction vehicles such as bulldozers, excavators and backhoes would be left overnight at construction sites and moved short distances from one segment of construction to another. Each segment of construction would take from two days for pipeline sections to three months for major facilities such as regulating ponds, pumping stations and certain canal facilities. The average duration of construction in any one area would be approximately one month. Construction traffic on roads such as Center Street, 1200 South, Mill Road, 1200 East and 2400 East would not be as concentrated as it would be on Highways 40 and 189.

Table 3-46 summarizes the estimated peak traffic and the increase over baseline conditions on Highways 40 and 189 during construction of the Proposed Action and alternatives. These maximums would occur periodically when the same road is used by construction workers and for hauling pipe and borrow material. This would occur during the two snow-free periods of the 19-month construction schedule (usually from March to November) on segments of Highway 40 north and southeast of Heber City. A daily peak of about 155 construction-related round trips would occur on Highway 40: 77 construction worker round-trips (including 12 management staff round-trips), 30 pipe truck round-trips and 48 borrow truck round-trips. Highway 189 would likely have the second largest increase in traffic. A daily peak of about 77 construction-related round-trips would occur on Highway 189, including 48 borrow round-trips and 29 construction worker round-trips. Construction traffic estimates are based on data in Table 1-19 (see Chapter 1, Section 1.12.4), Figure 1-8 (see Chapter 1, Section 1.12.2) and other information provided by the project engineers.

Table 3-46
Estimated Peak Traffic on Highways 40 and 189 During Construction of the Proposed Action and DRP Alternatives
(Daily Vehicle Trips)

	Highway 189 (From Charleston to Highway 40 Junction)	Highway 40 (From Jordanelle Dam to Highway 189 Junction)
PROPOSED ACTION (WCWEP WITH DANIEL REPLACEMENT PIPELINE)		
Baseline Traffic[1]	6,167	10,550
Total Peak Traffic During Construction[2]	6,321	10,860
Increase in Traffic	154	310
Percent Change	2.5%	2.9%
DRP WITH PIPELINE ALTERNATIVE		
Baseline Traffic[1]	6,167	10,550
Total Peak Traffic During Construction[2]	6,265	10,722
Increase in Traffic	98	172
Percent Change	1.6%	1.6%
DRP WITH CANAL ALTERNATIVE		
Baseline Traffic[1]	6,167	10,550
Total Peak Traffic During Construction[2]	6,265	10,730
Increase in Traffic	98	180
Percent Change	1.6%	1.7%

Notes:

[1] Baseline traffic data are estimates of Annual Average Daily Trips in the year 2000; Source: UDOT 1992 data adjusted with a 3 percent annual growth rate

[2] Total peak traffic during construction is baseline traffic plus peak daily vehicle trips during construction of the Proposed Action and alternatives

In addition to these peak traffic impacts, less concentrated and smaller increases in traffic would occur during most of the 19-month-long construction period. The total number of vehicles traveling to construction sites at one time during construction would range from about 10 to 155 vehicles per day. A total of 14,825 construction-related round-trips would occur in the impact area of influence during the entire construction period.

The Proposed Action would increase traffic in the upper Strawberry River basin during rehabilitation of the DIC irrigation facilities as construction workers and vehicles travel to and within the basin. Construction equipment and construction workers' vehicles would use paved and unpaved roads in the basin during construction, which would likely cause minor delays to recreationists and other motorists who would need to follow or pass large trucks.

Construction of the HCSS would cause temporary and minor increases in traffic on Heber City roads as construction vehicles are used to install the system.

Traffic increases during construction would not be significant because they would only cause minor delays as motorists wait to pass large trucks. The capacities of the affected roads are more than sufficient to handle the estimated increases in traffic associated with construction and operation of the Proposed Action. The paved roads in Heber Valley typically have capacities ranging from 300 vehicles per hour on smaller roads to 1,000 vehicles per hour on Highways 40 and 189 (Sowby and Berg 1993; UDOT 1995). The capacity of Highway 40 would double once the UDOT upgrade (see Chapter 1, Section 1.7) is completed in the fall of 1997. Baseline traffic levels are low enough to accommodate traffic increases associated with the Proposed Action. For example, baseline AADT on Highway 40 (10,550 daily trips) plus the traffic associated with the Proposed Action (310 daily trips) would be well within the capacity of Highway 40 (i.e., a total of 10,860 daily trips during construction of the Proposed Action would average 453 vehicles per hour).

3.18.6.3.2 Physical Impacts on Roads During Construction. The Proposed Action would include 60 pipeline road crossings during construction, as defined in Table 3-47. These crossings and the placement of pipelines along the shoulders of roads would cause some short delays to motorists during construction. However, the construction procedures and SOPs under the Proposed Action would limit most delays to less than 5 minutes. Short traffic detours that may be necessary to route traffic around pipeline trenching procedures would be controlled by flag persons. The primary pipeline road crossings would occur on Highway 40 southeast of Heber City, 1200 South, 2400 East and Dukes Lane. Smaller distribution pipes would need to cross many of these same roads and others in the impact area of influence, including Mill Road, Highway 40 north of Heber City and Highway 113 west of Heber City.

3.18.6.3.3 Transportation Impacts During Operation. One full-time O&M laborer and three part-time O&M staff would be employed during operation of the Proposed Action (see Table 1-18 in Chapter 1, Section 1.12.2). Up to four additional round-trips would occur each day on local roads, with fewer being more common. This would be a minor and unmeasurable increase in traffic on Heber Valley roads.

Recreationists would be attracted to streams that would be enhanced under the Proposed Action. However, the number of new fishermen and other recreationists would not be significant because access to and along the streams would not be provided under the Proposed Action (see Recreation Resources analysis in Section 3.16) without

Table 3-47
Pipeline Road Crossings Under the Proposed Action
(WCWEP With Daniel Replacement Pipeline)

Roads Crossed (and Number of Crossings)	Ownership	Roads Crossed (and Number of Crossings)	Ownership
Moulton Lane (1)	Private	400 North Street (1)	County or City
600 East Street (1)	County or City	Highway 40 (6)	State
2400 East Street (4)	County or City	1200 South Street (2)	County or City
1400 East Street (1)	County or City	1800 South Street (1)	County or City
Mill Road (2)	County or City	Center Creek Road (2)	County or City
Dukes Lane (1)	County or City	Little Sweden Road (1)	County or City
Coyote Lane (1)	County or City	600 South Street (3)	County or City
500 East Street (2)	County or City	State Street (4)	County or City
Highway 189 (4)	State	1200 West Street (3)	County or City
3000 South Street (3)	County or City	Highway 113 (3)	State
2400 West Street (1)	County or City	2400 South Street (4)	County or City
3000 West Street (1)	County or City	3400 West Street (1)	County or City
3150 South Street (1)	County or City	3300 South Street (1)	County or City
3400 South Street (1)	County or City	3500 South Street (1)	County or City
3500 West Street (1)	County or City	3600 South Street (1)	County or City
1800 West Street (1)	County or City		

permission from local landowners. The minor increase in recreation opportunities would therefore lead to a minor increase in traffic on roads that provide access to the streams, such as Highway 113, River Road and Highway 40.

An additional 10,000 recreationists per year would travel to the upper Strawberry River basin after streamflows and trout populations are restored in the basin. This would increase traffic in the basin and on Highways 40 and 189 in Heber Valley, and Highway 40 in Daniels Creek canyon as recreationists drive from Salt Lake City and the Provo/Orem area.

3.18.6.3.4 Impact Summary. The Proposed Action would increase traffic in the impact area of influence during construction and as shown on Table 3-46. An increase in recreation opportunities in the upper Strawberry River basin would cause an increase in recreation traffic in Heber Valley, Daniels Creek canyon and the upper Strawberry River basin. These traffic increases would not be significant because the affected roads have enough capacity to prevent significant delays to motorists.

The pipeline road crossings included in the Proposed Action and listed on Table 3-47 would cause temporary damage to roads and minor delays to motorists.

3.18.6.4 Daniel Replacement Project With Pipeline Alternative

3.18.6.4.1 Traffic Increases During Construction. Construction of the DRP With Pipeline Alternative would cause the same types of transportation impacts as described for the Proposed Action in Section 3.18.6.3.1 and Table 3-46. However, the magnitude and location of the impacts would be different. A peak of about 86 construction-related round-trips (172 daily trips) would occur on Highway 40 and 49 round-trips (98 daily trips) on Highway 189. The maximum percentage increase in daily traffic during construction of this alternative would be small, approximately 1.6 percent on both Highways 40 and 189. The percentage increases on some of the smaller roads in the impact area of influence would be higher but still minor, and well within the capacity of the roadways. Roads west and southwest of Heber City would not be affected because this alternative would not include any proposed facilities in these areas. Construction traffic estimates are based on data in Table 1-19 (see Chapter 1, Section 1.12.4), Figure 1-8 (see Chapter 1, Section 1.12.2) and other information provided by the project engineers.

3.18.6.4.2 Physical Impacts on Roads During Construction. Construction of the DRP With Pipeline Alternative would require 12 pipeline road crossings on Highway 32 near the junction with Highway 40, Center Street, Center Creek Road, and other small roads near Heber City (see Table 3-48). These crossings and the placement of pipelines along the shoulders of roads would cause some delays to motorists during construction. However, the construction procedures and SOPs would limit most delays to less than 5 minutes. Short traffic detours that may be necessary to route traffic around pipeline trenching procedures would be controlled by flag persons.

Table 3-48
Pipeline Road Crossings Under the DRP With Pipeline Alternative

Roads Crossed (and Number of Crossings)	Ownership
Moulton Lane (1)	Private
Highway 32 (1)	State
600 East Street (1)	County or City
600 South Street (1)	County or City
Mill Road (1)	County or City
Highway 40 (2)	State
Coyote Lane (1)	County or City
Center Street (1)	County or City
Center Creek Road (1)	County or City
Little Sweden Road (2)	County or City

3.18.6.4.3 Transportation Impacts During Operation. A minor increase in traffic would occur under this alternative as O&M workers travel to their work sites. Only three part-time workers would be needed to operate and maintain the DRP With Pipeline Alternative.

This alternative would cause an increase in recreation-related traffic in Heber Valley, on

Highway 40 in Daniels Creek canyon and in the Strawberry River basin. An additional 10,000 recreationists per year would travel to the upper Strawberry River basin after the basin's streamflows and trout populations are restored. This would increase traffic in the basin and on Highways 40 and 189 in Heber Valley as recreationists drive from Salt Lake City and the Provo/Orem area. A net increase in traffic would occur on Highway 40 in Daniels Creek canyon since the increase in recreation use in the upper Strawberry River basin would be greater than the decrease in Daniels Creek recreation use.

3.18.6.4.4 Impact Summary. The DRP With Pipeline Alternative would increase traffic in the impact area of influence during construction and as summarized on Table 3-46. An increase in recreation opportunities would cause an increase in recreation traffic. These increases would not be significant because the affected roads have enough capacity to prevent significant delays to motorists.

The pipeline road crossings included in the DRP With Pipeline Alternative and listed on Table 3-48 would cause temporary damage to roads and minor delays to motorists.

3.18.6.5 Daniel Replacement Project With Canal Alternative

3.18.6.5.1 Traffic Increases During Construction. The construction-related traffic impacts of the DRP With Canal Alternative would be virtually the same as the impacts described for the DRP With Pipeline Alternative in Section 3.18.6.4.1.

3.18.6.5.2 Physical Impacts on Roads During Construction. Construction of the DRP With Canal Alternative would include four pipeline road crossings (see Table 3-49). These crossings, and the placement of pipelines along the shoulders of roads, would cause short delays to motorists. However, the construction procedures and SOPs would limit most delays to less than 5 minutes.

3.18.6.5.3 Transportation Impacts During Operation. Transportation impacts during operation of the DRP With Canal Alternative would essentially be the same as the operation-related impacts described for the DRP With Pipeline Alternative in Section 3.18.6.4.3. Four part-time workers would operate and maintain this alternative.

Table 3-49
Pipeline Road Crossings Under the DRP With Canal Alternative

Roads Crossed (and Number of Crossings)	Ownership
Highway 32 (1)	State
Little Sweden Road (2)	County or City
Highway 40 (1)	State

3.18.6.5.4 Impact Summary. The DRP With Canal Alternative would increase traffic in the impact area of influence during construction and as summarized on Table 3-46. This alternative would cause an increase in recreation opportunities and thus an increase in recreation traffic. However, the increase in traffic would not be significant because the affected roads have enough capacity to prevent significant delays to motorists.

The pipeline road crossings included in the DRP With Canal Alternative and listed on Table 3-49 would cause temporary damage to roads and minor delays to motorists.

3.18.6.6 No Action Alternative

The No Action Alternative would have no impacts on transportation in the impact area of influence. The baseline transportation conditions described in Section 3.18.5 would continue under the No Action Alternative.

3.19 Mitigation

3.19.1 Introduction

This section describes proposed mitigation for significant impacts caused by the Proposed Action and DRP alternatives. Mitigation measures are proposed where feasible and practical for resources that would incur significant impacts.

3.19.2 Water Resources

Some wells could potentially become inoperable during critically dry years as a result of lowered groundwater levels under the Proposed Action. Possible mitigation measures include deepening or re-drilling the wells to restore operation or providing a connection to a domestic water distribution system, if available in the area. CUWCD would set aside a reserve fund as part of the capital cost of the Proposed Action for WCSSA to monitor water levels monthly in the wells potentially affected. This would be done before the Proposed Action is constructed and for 6 years after it becomes operational to determine which wells would be affected. Reserve funds would then be used to replace or deepen the affected wells. These potential mitigation measures would have no residual adverse impacts on water supply.

3.19.3 Aquatic Resources

Mitigation may be required for leatherside chub in Heber Valley streams that would receive supplemental instream flows under the Proposed Action. While these flows may be optimal for cutthroat trout the leatherside chub, which prefers relatively warmer and slower-moving waters compared to trout, may be adversely affected. Additional information is needed on the distribution and habitat of this species before determining the likelihood of these potential impacts. Since the leatherside chub is a species of special status in the State of Utah, the following actions are recommended by CUWCD as proposed mitigation:

- A survey would be conducted prior to construction activities to identify leatherside chub population centers and learn more about the status of the species
- Areas outside the impact area of influence that contain populations that would benefit from habitat enhancement would be enhanced and protected in accordance with an agreement to be finalized with the FWS and Utah Division of Wildlife Resources

The predicted loss of naturally reproducing cutthroat trout in upper Daniels Creek as a result of termination of the DIC diversion is unmitigable. Supplemental instream flows in this portion of upper Daniels Creek would be required to mitigate for this impact and there is no source of water for such flows.

3.19.4 Threatened and Endangered Species

Although impacts on peregrine falcon and bald eagle would be minimal, all direct disturbance of habitat would be fully replaced as part of wetland restoration under the SOPs described in Chapter 1, Section 1.12.9.

Proposed wetland restoration under the SOPs (see Chapter 1, Section 1.12.9) is expected to fully replace spotted frog habitat that would be impacted by construction of the DRP alternatives. Additional measures would be developed if wetland restoration did not meet habitat needs. A detailed, long-term monitoring plan also would be designed and implemented in conjunction with wetland mitigation. The plan would include measures to determine the success of habitat recovery after disturbance, re-population of the restored area and relocation efforts. Also, barriers would be placed around the construction site to prevent spotted frogs from entering, and measures would be designed for relocating frogs that are discovered in the area during construction. Orange fencing would be installed to prevent construction equipment from unnecessarily entering occupied habitat. All potential mitigation measures would be finalized with the FWS and Utah Division of Wildlife Resources.

Spotted frog habitat in emergent marsh, open water and wet meadow areas of northern Heber Valley would be inventoried to more accurately identify occupied areas before construction. Surveys for egg masses would be conducted in early April during the year construction is scheduled. Results of these surveys and records of known spotted frog locations would be used to guide appropriate conservation measures.

Impacts on spotted frogs could be minimized by restricting construction activities in areas that are known to be occupied by spotted frogs. Frog activity in occupied habitats occurs from hibernation in October to transformation of most tadpoles into adult frogs. This conservation measure would avoid disturbance of reproduction and minimize the loss of egg masses and tadpoles. In addition, it would avoid the mortality of immobile, hibernating individuals that would not be able to escape from construction equipment.

Direct effects on spotted frogs would be minimized by conducting rescue and relocation of adult frogs prior to starting construction and constructing a barrier or fence between the construction corridor and adjacent undisturbed habitat. Spring surveys would be conducted to determine if egg masses are present or absent. Adult frogs would be collected from the immediate area and transferred to the adjacent habitat during the late summer and fall months. The construction area would be fenced with silt fencing high enough to prevent re-entry of frogs during construction. The silt fencing would remain in place until the habitat is restored. After construction and restoration are complete, the barrier would be removed to allow frogs to return to the site. Rescue and relocation of frogs would minimize effects on the population. It is important to note that the success of frog relocation would be uncertain since monitoring has rarely been implemented to determine success of past relocation efforts. Some evidence suggests that ranid frogs imprint on their neonatal habitat and may attempt to return to hatching areas. Sites designated to receive relocated frogs would be selected with input from the FWS and Utah Division of Wildlife Resources.

A detailed, long-term monitoring plan should be designed and implemented to determine the success of habitat recovery after disturbance, re-population of the restored area and relocation efforts. Other measures should be implemented such as placing barriers around the construction site to prevent spotted frogs from entering the area and designing measures for relocating frogs that are discovered within the area during construction.

3.19.5 Cultural Resources

Potential mitigation measures for significant adverse impacts on cultural resources from the Proposed Action and alternatives are presented in the following subsections for Heber Valley and the upper Strawberry River basin.

3.19.5.1 Heber Valley

Before construction a complete inventory of the impact area of influence for prehistoric and historic resources would be completed for all areas to be disturbed. The inventory would be conducted under a Programmatic Agreement (PA), which would ensure that all potentially significant impacts on cultural resources are identified, NRHP eligibility is determined and appropriate mitigation implemented. HABS/HAER documentation, excavation or other measures deemed appropriate would be used to mitigate effects on any NRHP-eligible sites located.

A paleontological inventory also would be conducted at potential fossil sites that may be disturbed in the impact area of influence. If located, fossils would be collected or sampled. In critically sensitive localities a paleontologist would be required to monitor excavation work.

3.19.5.2 Upper Strawberry River Basin

Construction and maintenance of the Proposed Action would destroy the integrity of the NRHP-eligible DIC diversion facilities in the upper Strawberry River basin. Mitigation for destruction of this historic resource was determined at a joint meeting between the CUWCD, the Utah State Historic Preservation Office (SHPO) and the USFS (Uinta National Forest). Mitigation would include constructing a small parking lot near the Mill B Flat corral and a foot-trail along the canal embankment about 1.75 miles south-southwest to the entrance of the McGuire Tunnel. A brochure would be written, interpreting the history and remaining features of the canal system, and a series of newspaper articles on the history of the DIC diversion facilities would be written and submitted for publication in the local newspaper.

3.20 Unavoidable Adverse Impacts

3.20.1 Introduction

This section describes unavoidable adverse impacts that would occur under the Proposed Action and DRP alternatives. These impacts are presented by resource.

The following resources would have no unavoidable adverse impacts under the Proposed Action and DRP alternatives:

- Wetlands
- Wildlife resources
- Recreation resources

Unavoidable adverse impacts listed below are for the Proposed Action and DRP alternatives unless otherwise noted.

3.20.2 Water Resources

Groundwater levels in portions of Heber Valley and average reservoir storage levels in Jordanelle and Deer Creek reservoirs would be lower; streamflow would be reduced in Daniels Creek above irrigation diversions; pumping lift distances would increase for wells in the southeast portion of Heber Valley; and reduced CUP agricultural water supply availability in Heber Valley would be reduced, which would increase irrigation shortages compared to baseline.

3.20.3 Water Quality

Minor increases in groundwater NO_3 concentrations would occur during wet hydrologic conditions. Deer Creek Reservoir would experience minor increases in TSS loads during average and dry hydrologic conditions.

3.20.4 Aquatic Resources

The cutthroat trout standing crop would decrease in upper Daniels Creek after transbasin water diversions are eliminated because less habitat area would be available for natural reproduction under the lower natural stream flows. Even though cutthroat trout production would be at a lower level compared to baseline, the total trout biomass in upper Daniels Creek is likely to stay near baseline levels when it is stocked with hatchery-produced rainbow trout.

3.20.5 Threatened and Endangered Species

Construction is likely to temporarily displace roosting and perching bald eagles. Under the DRP alternatives, construction could cause some mortality and reduced reproductive success of spotted frog adults, tadpoles and egg masses even with the conservation measures.

3.20.6 Soil Resources

Streambeds and streambanks in the upper Strawberry River would experience a minor and gradual increase in erosion.

3.20.7 Mineral and Energy Resources

Electricity would be used to operate pumps and fuel would be consumed by vehicles during construction and operation. Power lines would be extended to pump stations and modified to include three-phase power.

3.20.8 Air Quality

Vehicle and dust emissions would increase in Heber Valley and the upper Strawberry River basin during construction. Increased recreation traffic also would increase vehicle emissions during operation.

3.20.9 Agriculture Resources

Interruption of irrigation water supply during construction would result in the loss of up to 1 year of crop production.

3.20.10 Socioeconomics

Gross farm revenue would experience a minor loss from the temporary disturbance of grazing and cropland during construction and the permanent removal of a small amount of grazing and cropland. Some farmers, local residents and property owners would be adversely impacted during and after construction along the five streams in Heber Valley that would receive supplemental instream flows.

3.20.11 Health and Safety

There would be a slight increase in the risk of traffic accidents during and after construction of the Proposed Action and alternatives; a slight increase in the risk of flooding hazards for people living near the Daniel Replacement Pipeline and northeast of Heber City under the DRP With Pipeline Alternative; and a slight increase in the risk of flooding hazards for some people living near the enlarged Timpanogos Canal under the DRP With Canal Alternative.

3.20.12 Noise

Noise levels would exceed significance criteria for people within about 50 feet of construction sites. Some people would experience significant noise impacts during construction along smaller roads in the impact area of influence that are not traveled by large trucks under baseline conditions. Recreationists' vehicles also would generate noise along roads as they drive to the upper Strawberry River basin.

3.20.13 Visual Resources

Construction of pump stations, regulating ponds and O&M roads would alter the color, texture and line of existing visual features in Heber Valley. Man-made structures also would be introduced into the agricultural landscape.

3.20.14 Cultural Resources

DIC diversion facilities in the upper Strawberry River basin would be abandoned and removed, which would impact portions of the canal system and compromise the integrity of the historic property. No known cultural resources would be adversely impacted in Heber Valley by the Proposed Action and alternatives, but it is likely that historic farmsteads, sheds, fences and other historic features, which have not yet been recorded, could be unavoidably and adversely impacted.

3.20.15 Transportation

Traffic would increase in the impact area of influence during construction. Pipeline construction at road crossings would cause temporary damage to roads and minor delays to motorists. During operation, recreation traffic would increase in the upper Strawberry River basin, Daniels Canyon and Heber Valley.

3.21 Cumulative Impacts

3.21.1 Introduction

This section describes cumulative impacts of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), DRP alternatives and the interrelated projects described in Chapter 1, Section 1.7 of this EIS. The PRRP Proposed Action (Riverine Habitat Restoration) is considered an interrelated project for purposes of evaluating cumulative impacts in this section.

3.21.2 Cumulative Impacts Caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Interrelated Projects

3.21.2.1 Water Resources

Past interrelated projects have caused the following cumulative impacts on surface water resources in Heber Valley:

- An increase in Provo River flows during spring and early summer from the Weber, Duschene and Strawberry River transbasin diversions
- A decrease in flows in the upper and middle reaches of the Provo River and other Heber Valley streams during summer and fall. This is caused primarily by Heber Valley irrigation diversions. Flows in the lower portion of the Provo River are higher in the summer and fall than under natural conditions due to the return flow of ground water.
- Jordanelle Dam has changed the volume and timing of downstream flows in the Provo River. In general, it has reduced high runoff flows in the spring and increased flows below the dam during summer and early fall when water supply demands are at their highest.
- The completion of Deer Creek Reservoir inundated the Provo River in the lower portion of Heber Valley
- The availability of water supplies has increased from the Weber, Duschene and Strawberry River transbasin diversions, and will soon increase again once Jordanelle Reservoir is in full operation

Groundwater levels in Heber Valley have risen in areas affected by flood irrigation. The greatest increases in groundwater levels have occurred in the area southeast of Heber City.

Future cumulative impacts of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects on water resources would be virtually the same as the water resource impacts of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) by itself. The specific impacts are too numerous to include in this section and are described in Section 3.2.6.3 of this EIS. They include an increase in the flow of streams in the upper Strawberry River basin, a decrease in the flow of Daniels Creek, an increase in the flow of Rock Ditch, London Ditch, Creamery Ditch, lower Lake Creek and Spring Creek, and a reduction in Heber Valley groundwater levels.

3.21.2.2 Water Quality

Past interrelated projects have affected water quality in Heber Valley. These activities included settlement of the valley and conversion of the natural environment to agricultural uses, and subsequently, residential and other urban development. These activities increased nonpoint source pollution and increased pollution from human waste. However, surface water quality conditions in Heber Valley and Deer Creek Reservoir have improved over the last 15 years. These improvements are because of projects that addressed the point and nonpoint pollution sources in the valley, including the Rural Clean Water and Clean Lakes Programs, construction of a sediment settling pond at the Midway Fish Hatchery and completion of the Heber Valley regional wastewater treatment plant. Construction of Jordanelle Reservoir is improving water quality in Heber Valley canals and streams and Deer Creek Reservoir. These ongoing changes include reductions in sediment and phosphorus loads to Heber Valley (Sowby and Berg 1984). Additionally, Jordanelle Reservoir was constructed with a Selected Level Outlet Works (SLOW) to help protect downstream water quality by allowing water to be selectively discharged from different layers in the reservoir depending on water temperature.

Cumulative surface water quality impacts in affected streams and canals would include changes in nutrient and sediment concentrations, and temperature changes. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects would cause minor increases in nutrient and sediment concentrations in streams and canals where construction activities occur. However, these projects would cause long-term decreases in nutrient and sediment concentrations after construction is complete and sites are stabilized. The PRRP Proposed Action (Riverine Habitat Restoration) would cause a minor increase in the temperature of the Provo River. This impact would persist until riparian vegetation along disturbed portions of the Provo River is re-established and grows to a size and height that shades the water surface, approximately 15 to 30 years for cottonwood trees.

Cumulative surface water quality impacts in Deer Creek Reservoir include increased sediment loads and eutrophication. The cumulative impacts of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects would cause increases in TSS loads during and immediately following construction, and in long-term decreases in TSS loads to Deer Creek Reservoir following construction and site stabilization. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects would improve, or have no influence on TP loads to Deer Creek Reservoir, and the net cumulative impact would be a decrease in baseline TP loads. This would result in a minor reduction, or no change in reservoir TP concentrations. There would be no cumulative impacts on temperature and mixing status in Deer Creek Reservoir from the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects.

Future urban development in Heber Valley may create additional non-point source pollution. A study by Hansen, Allen, and Luce (1994) estimates that urban growth in the valley will increase groundwater nitrate concentrations by 10 percent. This increase would not cause nitrate concentrations to approach or exceed the State drinking water standard of 10 mg/L. The Heber Valley portion of the Tri-Valley Watershed Plan and expansion of the regional wastewater treatment plant would improve groundwater quality, while the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would cause a minor increase in nitrate concentrations.

3.21.2.3 Wetlands

Past modifications to the Provo River channel have reduced riparian vegetation and other wetlands. While past urban and agricultural development in Heber Valley has adversely affected some wetlands, others have been created either directly or indirectly by flood irrigation for agriculture.

Future interrelated projects are expected to mitigate all or most of the adverse wetlands impacts they cause. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would cause an overall net gain of approximately 264.9 acres of wetlands. Some wet meadow wetlands that are not protected by the COE (referred to as "non-jurisdictional" wetlands) or the Wasatch County Planning Department may be directly or indirectly impacted in Heber Valley by future development projects without being mitigated.

3.21.2.4 Aquatic Resources

Past interrelated projects have caused a reduction in Heber Valley and upper Strawberry River basin aquatic resources. Cutthroat trout no longer spawn in Heber Valley streams from Utah Lake and the total trout population of Heber Valley has declined significantly. DIC's transbasin diversions have reduced flows in streams of the upper Strawberry River basin and adversely impacted the basin's aquatic resources.

The streamflow and habitat improvements of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and the PRRP Proposed Action (Riverine Habitat Restoration) would cause an estimated increase in natural trout production of 43,274 pounds per year in the Provo River, Rock Ditch, London Ditch, Creamery Ditch, lower Lake Creek and Spring Creek, and the upper Strawberry River basin.

Other cumulative impacts from future interrelated projects would include positive water quality impacts of the Heber Valley portion of the Tri-Valley Watershed Plan and expansion of the regional wastewater treatment plant in Heber Valley, and minor disturbance to the aquatic habitat of Creamery Ditch from the Highway 40 upgrade north of Heber City.

Future cumulative impacts on non-game fish and their habitat and other aquatic resources would generally be the same as for game fish (trout). Improved streamflow and habitat restoration would cause a net increase in production of non-game fish that is not readily quantifiable.

3.21.2.5 Wildlife Resources

Past agricultural and urban development in Heber Valley has significantly reduced the habitat of the valley's native wildlife. Modifications in and along the Provo River channel, livestock grazing and irrigation diversions have reduced the amount of riparian wildlife habitat along the Provo River, London Ditch, Creamery Ditch, lower Lake Creek and Spring Creek.

The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would cause a net increase of approximately 271.9 acres of wildlife habitat in the upper Strawberry River basin and along the Provo River in Heber Valley. Approximately 1,216 cottonwood trees along the Provo River would be removed during construction of the PRRP Proposed Action (Riverine Habitat Restoration). Cumulative impacts would occur during the time required for revegetated areas and regenerated cottonwood trees to achieve a size and height that provide full wildlife habitat value. This varies from 2 to 3 years for emergent wetland vegetation, 5 to 10 years for willows and shrub understory vegetation and 15 to 30 years for cottonwood trees. An additional 114.7 acres of existing and undeveloped wildlife habitat would be permanently protected along the Provo River corridor.

The amount of wildlife habitat affected by two interrelated projects — the Highway 189 upgrade project and the Deer Creek Dam/Highway 189 buttressing project is not readily available. However, these two projects are expected to cause minor contributions to cumulative impacts since the work would occur in areas that do not currently provide important wildlife habitat. Future urban development in Heber Valley would adversely impact species that rely upon upland habitat and irrigated and non-irrigated agricultural lands.

3.21.2.6 Threatened and Endangered Species

Past agricultural and urban development and modifications to the Provo River channel in Heber Valley have greatly reduced the habitat of Ute ladies'-tresses, spotted frog, peregrine falcon and bald eagle. The transbasin diversion from the upper Strawberry River basin to Daniels Creek, and livestock grazing in Uinta National Forest, have adversely impacted bald eagle and peregrine falcon habitat in the upper Strawberry River basin. Past water development projects on the Provo River, including Deer Creek Reservoir, have adversely affected the June sucker by decreasing flows in the lower Provo River during their spawning and rearing period. These past impacts have led to the baseline habitat conditions described in Section 3.7.5.

The following subsections describe future cumulative impacts that could be caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects. The June sucker and spotted frog are not included in the following discussion because the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would not cause impacts on these species or their habitat.

3.21.2.6.1 Peregrine Falcon. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade would cause the following temporary and permanent cumulative impacts on the foraging habitat of peregrine falcons:

- An increase of approximately 40.2 acres of peregrine falcon foraging habitat in the upper Strawberry River basin after the transbasin diversion is terminated under the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline)
- Temporary disturbance of 22.2 acres of peregrine falcon foraging habitat along the Provo River
- Permanent removal of approximately 58.2 acres of wet meadow and emergent marsh foraging habitat along the Provo River in Heber Valley from the construction of the PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade
- An indirect loss of about 20.7 acres of low function and value wet meadow wetlands in those portions of Heber Valley affected by the groundwater elevation drawdown associated with the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline)

Two parcels of land have been acquired to offset impacts on peregrine falcon foraging habitat from interrelated projects in Heber Valley. A 64.7-acre parcel of land situated along the Provo River has been acquired by the DOI to offset wetland impacts of the PRRP Proposed Action (Riverine Habitat Restoration). This DOI parcel contains peregrine falcon foraging habitat but was grazed by livestock under previous ownership and not managed for wetland functions and values. The wetland functions and values of the DOI parcel would be protected and enhanced, improving foraging habitat for peregrine falcons. The second parcel of land involves 6 acres of wetland recently acquired by UDOT to offset impacts of the Highway 40 upgrade. This UDOT parcel would be protected and enhanced, improving foraging habitat for peregrine falcons.

Additional foraging habitat would likely be directly or indirectly impacted in Heber Valley and near Jordanelle Reservoir as planned subdivisions, hotels and other development projects are built on undeveloped or agricultural land.

3.21.2.6.2 Bald Eagle. Bald eagle would experience minor, temporary and adverse cumulative impacts as they are disturbed by noise and the loss of trees used for roosting and perching during the construction of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), the PRRP Proposed Action (Riverine Habitat Restoration), Highway 40 upgrade, and Deer Creek Dam buttressing project. These impacts would be temporary and would last approximately 15 to 30 years until trees are mature and reach an adequate size after construction. About 2.1 acres of riparian woodland used for roosting and perching would be permanently removed in upper Strawberry River basin. About 9.7 acres of riparian woodland and 1,216 mature cottonwood trees would be permanently removed in Heber Valley. The level of adverse impacts would not induce bald eagle to winter elsewhere or cause excess stress that would affect the health of individuals because the impact area of influence does not support large concentrations of bald eagle, and other habitat is available during displacement.

Bald eagles would benefit from the long-term impacts of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), PRRP Proposed Action (Riverine Habitat Restoration), Tri-Valley Watershed Plan, and expansion of the regional wastewater treatment plant in Heber Valley. All of these projects would increase fish populations and/or improve water quality and riparian habitats. The PRRP Proposed Action (Riverine Habitat Restoration) also would cause a net increase of approximately 246.8 acres of riparian woodland with wetland mosaic that would provide roosting and perching habitat for bald eagle.

3.21.2.6.3 Ute Ladies'-tresses. The only known populations of the orchid that could be affected by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) or interrelated projects are found near the Provo River in Heber Valley. These populations would be protected during construction of the PRRP Proposed Action (Riverine Habitat Restoration). Ute ladies'-tresses habitat would increase over the long-term by approximately 212.7 acres. This could cause an increase in the density, distribution and conservation of the species in Heber Valley. An additional 70.7 acres of Ute ladies'-tresses habitat would be protected and enhanced in Heber Valley.

The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), PRRP Proposed Action (Riverine Habitat Restoration) , Highway 40 upgrade, and the Deer Creek Dam buttressing project all would directly or indirectly impact potential Ute ladies'-tresses habitat. They would not impact known populations of the orchid. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) only would indirectly convert 20.7 acres of marginal habitat consisting of low function and value wet meadow wetlands to uplands. The PRRP Proposed Action (Riverine Habitat Restoration) would temporarily disturb 24.7 acres and permanently remove 77.2 acres of potential habitat.

Additional irrigation-induced wetlands providing marginal Ute ladies'-tresses habitat in Heber Valley could be directly or indirectly impacted as subdivisions and other residential development projects are built on lands that are currently irrigated for agricultural purposes.

3.21.2.7 Soil Resources

Past Provo River modifications, and agricultural and urban development in Heber Valley has caused some soil erosion in the valley. All of the future interrelated projects listed in Chapter 1, Section 1.7.1 and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) have the potential to cause some erosion during and immediately after construction. During operation, there would be a gradual decrease in erosion potential and a net reduction in streambed erosion in the Provo River and the streams affected by the Tri-Valley Watershed Plan.

3.21.2.8 Mineral and Energy Resources

The use of energy and mineral resources has increased in Heber Valley in direct proportion to the amount of urban and agricultural development that has occurred in the valley. Future energy use by vehicles and equipment during construction and operation of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects would cause cumulative impacts on energy resources. A total of about 294,200 gallons of fuel would be used during construction of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration). Approximately 202,900 gallons of fuel would be used during the two-year overlap in their construction schedules. About 3 million kwhr/year of electricity would be used to run the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) pump stations and to pump groundwater a greater distance during operation. Additional gasoline would be used by recreationists in the impact area of influence after construction.

The UDOT projects planned for Highway 189 in the Provo River canyon and Highway 40 in Heber Valley may require local borrow material and would use energy during construction. Depending on the material requirements and timing of construction, these projects could affect the same gravel mining operations that would be affected by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline). The specific cumulative impacts on mineral and energy resources of these interrelated projects are not readily quantifiable.

3.21.2.9 Air Quality

While Heber Valley's air quality is generally very good, it has been degraded by past agricultural and urban development. Past development has led to an increase in vehicle emissions, dust and smoke from agricultural practices and smoke from fireplaces and wood stoves.

Future UDOT highway upgrade projects, urban development in Heber Valley and the PRRP Proposed Action (Riverine Habitat Restoration) could cause future cumulative air quality impacts with the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline). Construction of the Highway 40 and 189 upgrades would increase traffic and vehicle emissions. The early phases of these upgrades would likely occur simultaneously with the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and the first two years of PRRP Proposed Action (Riverine Habitat Restoration) construction. Future urban development in Heber Valley and related population growth would likely increase vehicle emissions in the valley and degrade its air quality. Data necessary for quantifying the contribution of UDOT projects and future urban development to cumulative air quality impacts in Heber Valley are not readily available.

There would be a two-year overlap in the construction of the PRRP Proposed Action (Riverine Habitat Restoration) and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline). During this time, the maximum vehicle emissions during any twelve months of construction would be a total of 230 tons of nitrogen oxides, 30 tons of sulfur oxides, and 16 tons of particulates. After construction of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) is completed, cumulative air quality impacts in Heber Valley would be caused by the vehicles of recreationists and cumulative impacts in the Provo River canyon would be caused by both of these projects and the latter phases of the UDOT Highway 189 upgrade.

3.21.2.10 Agriculture Resources

Agricultural production in Heber Valley has increased over time and approximately 12,800 acres in the valley are currently irrigated for agricultural purposes. Additional lands in the valley and surrounding uplands are used for grazing. Recent urban development has taken some land out of production and planned subdivisions are expected to cause additional adverse impacts on agriculture.

Future cumulative impacts on agriculture from construction of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would include temporary disruption of production on approximately 230.6 acres of grazing and cropland. There would be a cumulative and permanent loss of about 24.7 acres of grazing land and 189.4 acres of cropland. This would cause the following cumulative production decreases during construction: about 1,562 AUMs on grazing land and pasture, 1,960 bushels of barley and 547 tons of alfalfa. During the two-year overlap in construction of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration), the cumulative change in production would be a net decrease of 356 AUMs, 547 tons of alfalfa and 1,960 bushels of barley.

After construction, the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would combine to cause an annual net increase of 798 AUMs and 2,011 tons of alfalfa. There also would be a net decrease in barley production of 120 bushels per year. In addition to these cumulative changes in production, there would be a periodic and minor loss of production in the flood plain of the Provo River during flooding. The PRRP Proposed Action (Riverine Habitat Restoration) could cause adverse impacts on agricultural practices and operations along the Provo River.

Agricultural land affected by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and the Heber Valley portion of the Tri-Valley Watershed Plan would benefit from a long-term increase in crop yields, primarily because of the conversion from flood to sprinkler irrigation and other actions that provide more efficient agricultural practices and operations. The Highway 40 upgrade and expansion of the regional wastewater plant also would cause permanent removal of a minor amount of agricultural land.

3.21.2.11 Socioeconomics

The economy of Heber Valley and Wasatch County has grown over time from agricultural development and more recently, a boom in the real estate and housing markets. A recent influx of new residents is expected to continue and this demographic change is behind an ongoing change in social conditions for the valley's residents.

Future cumulative employment, revenue and income impacts would occur during the simultaneous construction of the WCWEP and DRP Proposed Action (WCWEP and Daniel Replacement Pipeline), PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade. The cumulative and peak increase in construction-related employment caused by these 3 projects would be approximately 164 jobs. The WCWEP and DRP Proposed Action (WCWEP and Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would cause a reduction in gross farm revenues during construction as land is removed from production. The cumulative loss of gross farm revenue would be about $53,000. Gross revenue in the construction and retail trade sectors would increase. The cumulative and peak annual increase in total Wasatch County revenue during construction would be approximately $733,000.

After construction, there would be a cumulative net increase of about $123,000 in total annual gross revenue in the farm sector of Wasatch County's economy. The retail trade sector of the county would experience an annual increase in gross revenue of about $179,000; therefore, the total increase in the county's gross revenue would thus be approximately $395,000 per year. This would lead to an increase in income, sales tax revenue and income tax revenue. Property tax revenues would drop about $159,000 per year as payments in lieu of taxes from the federal government begin on land that is currently private property. The PRRP Proposed Action (Riverine Habitat Restoration) would cause some significant and adverse impacts to farmers, local landowners and residents along the Provo River corridor.

The Heber Valley portion of the Tri-Valley Watershed Plan would help increase productivity of agricultural resources in Heber Valley, however the impacts of the Tri-Valley Watershed Plan on agricultural economics are not readily quantifiable. Future urban development in Heber Valley will continue to take agricultural land out of production but would benefit other sectors of the economy. Such development also would continue to change social conditions in Wasatch County and raise property tax revenue for the County.

3.21.2.12 Health and Safety

Health and safety risks have increased in Heber Valley as traffic associated with past development has increased. In the future, the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects could combine to cause cumulative health and safety risks related to traffic increases. Each of these projects would increase traffic during their construction periods. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would increase recreation-related traffic after their construction is completed. This would increase the risk of traffic accidents on roads that would experience cumulative traffic increases, i.e., Highways 80, 40 and 189 and smaller roads in Heber Valley. However, the risk would be minimal because none of these projects would cause large increases in traffic, and additional traffic would be dispersed over a fairly large area.

3.21.2.13 Noise

Past urban and agricultural development has increased noise levels in Heber Valley. Future interrelated projects that could cause cumulative noise impacts with the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), are the PRRP Proposed Action (Riverine Habitat Restoration), the Highway 189 upgrade in the Provo River canyon, expansion of the regional wastewater treatment plant and the Highway 40 upgrade north of Heber City. During the overlap in construction of these projects, cumulative noise impacts would occur as workers and equipment from the different projects would sometimes travel on the same roads, primarily Highway 40 in Heber Valley and Highway 189 in the Provo River canyon.

After construction, the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would cause cumulative noise impacts on and near roads that experience simultaneous increases in recreation traffic associated with both projects. This would likely occur on Highway 40 in Heber Valley and Highway 189 in the Provo River canyon and Heber Valley as recreationists drive to the Provo River and Strawberry River basin.

3.21.2.14 *Visual Resources*

Past interrelated projects have changed the visual character of Heber Valley in areas affected by Provo River modifications, construction of Jordanelle and Deer Creek reservoirs and agricultural and urban development. However, most of the valley is still primarily open space with scenic vistas.

Future interrelated projects could cause cumulative impacts on visual resources and include the Highway 40 upgrade north of Heber City, additional urbanization in Heber Valley, expansion of the regional wastewater treatment plant in Heber Valley, and the PRRP Proposed Action (Riverine Habitat Restoration). These interrelated projects and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) could cause adverse visual cumulative impacts by generating dust, using construction vehicles and equipment, and land and tree clearing during construction. After construction, adverse cumulative visual impacts would result from the addition of more man-made and urban features, such as houses, power lines and telephone poles, in a predominantly agricultural setting. Positive cumulative visual impacts would occur along enhanced riparian corridors in the upper Strawberry River.

3.21.2.15 *Recreation Resources*

Recreation opportunities in Heber Valley and the upper Strawberry River basin have decreased as trout populations have declined in their streams. Reservoir-related recreation opportunities increased after Deer Creek, Jordanelle and Strawberry reservoirs were completed. A cumulative increase in future recreation use would be caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and the PRRP Proposed Action (Riverine Habitat Restoration). Together, they have the potential to increase recreational fishing by a total of approximately 213,100 angler days per year. An additional 10,000 angler days per year would be made possible by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) in the upper Strawberry River basin. This would help mitigate losses attributed to the Strawberry Aqueduct and Collection System.

3.21.2.16 *Cultural Resources*

Settlement of Heber Valley, past interrelated projects and vandalism have caused adverse impacts on the valley's historic and cultural resources. Future cumulative impacts on cultural resources from the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and interrelated projects are not quantifiable because the data base of known sites is incomplete and the extent and location of potentially affected cultural resources are unknown. Vandalism of historic sites could increase in Heber Valley as the valley's population increases.

3.21.2.17 *Transportation*

Traffic has increased in Heber Valley as the valley's population has grown and as more visitors drive through the valley on their way to ski resorts, reservoirs and other recreation areas. Interrelated projects that would cause future cumulative transportation impacts with the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), are the PRRP Proposed Action (Riverine Habitat Restoration), the Highway 40 upgrade north of Heber City and the Highway 189 upgrade in Provo River canyon.

Construction of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), Highway 40 upgrade and PRRP Proposed Action (Riverine Habitat Restoration) would cause cumulative traffic impacts on Highways 40 and 189 in Heber Valley during the overlap in their construction schedules. The peak, cumulative increase in traffic on Highway 40 would be approximately 520 daily trips and 259 daily trips on Highway 189.

Other interrelated projects would cause cumulative impacts during construction on Highway 189 in the Provo River canyon where workers and construction vehicles associated with the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), PRRP Proposed Action (Riverine Habitat Restoration) and Highway 189 upgrade would travel simultaneously. The peak cumulative increase in traffic related to construction workers could be as high as 1,046 trips a day during the height of construction. This is a worst-case scenario since it is not known if UDOT would encourage or require carpooling. The Highway 189 upgrades would cause delays to motorists who would need to wait for construction to be completed in the narrow canyon. However, the SOPs and mitigation measures included in the Highway 189 projects would likely minimize adverse impacts on motorists and minimize adverse cumulative impacts.

Operation of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and PRRP Proposed Action (Riverine Habitat Restoration) would increase recreation-related traffic on Heber Valley roads and on Highway 189 in the Provo River canyon. Fishermen and other recreationists would use Highways 40 and 189 to travel from the Provo/Orem and Salt Lake City areas to the Provo River, upper Strawberry River basin and other areas. The increase in recreation-related traffic would begin during the last three phases of the Highway 189 upgrade. However, the cumulative increase in traffic would be within the designed capacity of the affected roads, and the SOPs and mitigation included in the last three phases of the Highway 189 upgrade would help avoid and minimize cumulative impacts in the Provo River canyon.

3.21.3 Cumulative Impacts Caused by the DRP With Pipeline Alternative and Interrelated Projects

The interrelated projects described in Chapter 1, Section 1.7 of this EIS also were included in the cumulative impacts analysis conducted for the DRP With Pipeline Alternative. Many of the cumulative impacts caused by the DRP With Pipeline Alternative and interrelated projects would be the same as those described for the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) in Section 3.21.2. Therefore, this section only describes cumulative impacts that would be different than those described in Section 3.21.2.

3.21.3.1 Water Resources

The cumulative impacts of the DRP With Pipeline Alternative and interrelated projects would be virtually the same as the impacts of the DRP With Pipeline Alternative by itself and would include the following impacts:

- Minor reductions in groundwater levels would occur in the eastern portion of Heber Valley
- The CUP agricultural water supplies of Heber Valley irrigation companies (other than DIC) would be reduced
- Flows would not increase in Rock Ditch, London Ditch, Creamery Ditch, lower Lake Creek and Spring Creek
- Flows would increase in the upper Strawberry River basin

3.21.3.2 Water Quality

Since there would be no supplemental instream flows provided under this alternative, there would be no short-term increases in nutrients and sediments in streams after completion of construction activities. TSS loads to Deer Creek Reservoir following construction would increase slightly under the DRP With Pipeline Alternative, but would decrease with the interrelated projects. Therefore, the cumulative sediment impacts would be no change or a long-term decrease in sediment load to Deer Creek Reservoir. The DRP With Pipeline Alternative, Heber Valley portion of the Tri-Valley Watershed Plan, and expansion of the regional wastewater treatment plant would cause a minor improvement in groundwater quality as nitrate concentrations decrease.

3.21.3.3 Wetlands

The DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would cause an overall net gain of approximately 285.6 acres of wetlands. The other interrelated projects would not increase wetlands and their negative impacts would be mitigated.

3.21.3.4 Aquatic Resources

The future cumulative increase in natural trout production caused by the DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would be 41,659 pounds per year. This would occur in the Provo River in Heber Valley and the upper Strawberry River basin.

3.21.3.5 Wildlife Resources

The DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would cause a net increase of approximately 292.6 acres of wildlife habitat in the upper Strawberry River basin and along the Provo River in Heber Valley.

3.21.3.6 Threatened and Endangered Species

3.21.3.6.1 Peregrine Falcon. The DRP With Pipeline Alternative, PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade would cause the following temporary and permanent cumulative impacts on the foraging habitat of peregrine falcons:

- An increase of approximately 40.2 acres of peregrine falcon foraging habitat in the upper Strawberry River basin after the transbasin diversion is terminated under the DRP With Pipeline Alternative
- Temporary disturbance of 29.1 acres of peregrine falcon foraging habitat along the Provo River from construction of the DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration)
- Permanent removal of approximately 58.2 acres of wet meadow and emergent marsh foraging habitat along the Provo River in Heber Valley from the construction of the PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade

Additional foraging habitat would likely be directly or indirectly impacted in Heber Valley and near Jordanelle Reservoir as planned subdivisions, hotels and other development projects are built on undeveloped or agricultural land.

3.21.3.6.2 Bald Eagle. The DRP With Pipeline Alternative and interrelated projects would have similar cumulative impacts on bald eagles and their habitat to those described in Section 3.21.2.6.2, except that there would be less trout available as prey because this alternative would not increase trout populations in Heber Valley streams.

3.21.3.6.3 Ute Ladies'-tresses. The DRP With Pipeline Alternative and interrelated projects would have the same potentially positive benefits on Ute ladies'-tresses habitat as described in Section 3.21.2.6.3.

The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), PRRP Proposed Action (Riverine Habitat Restoration) , Highway 40 upgrade, and the Deer Creek Dam buttressing project all would have direct or indirect cumulative impacts on potential Ute ladies'-tresses habitat. They would not impact known populations of the orchid. The DRP With Pipeline Alternative and the PRRP Proposed Action (Riverine Habitat Restoration) would temporarily disturb 31.7 acres and permanently remove 77.2 acres of potential habitat.

Additional irrigation-induced wetlands providing marginal Ute ladies'-tresses habitat in Heber Valley could be directly or indirectly impacted as subdivisions and other residential development projects are built on lands that are currently irrigated for agricultural purposes.

3.21.3.6.4 Spotted Frog. The DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would have temporary and permanent cumulative impacts on spotted frog and its habitat. About 24.1 acres of habitat would be temporarily disturbed during construction and then restored within two years. About 55.2 acres of spotted frog habitat would be permanently lost. These projects would cause reduced reproductive success and accidental mortality of adults, tadpoles and egg masses. These cumulative impacts on spotted frogs and their habitat would be important because low population numbers, fragmentation of habitat and varying spring flow conditions currently contribute to the decline of spotted frogs in Heber Valley.

About 90.9 acres of spotted frog habitat would be created and enhanced from implementation of the PRRP Proposed Action (Riverine Habitat Restoration). An additional 70.7 acres of spotted frog habitat is being protected and enhanced under the interrelated projects in Heber Valley.

3.21.3.7 Soil Resources

The types of cumulative impacts on soil resources caused by the DRP With Pipeline Alternative and interrelated projects would be the same as those described in Section 3.21.2.7. However, some of the impacts of the DRP With Pipeline Alternative would occur in different locations than the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline).

3.21.3.8 Mineral and Energy Resources

Overall, a total of about 185,000 gallons of fuel would be used during construction of this alternative and the PRRP Proposed Action (Riverine Habitat Restoration). Approximately 93,800 gallons of fuel would be used during the two-year overlap in their construction schedules. About 832,000 kwhr/yr of electricity would be used by the operation of the DRP With Pipeline Alternative's pumping plants.

3.21.3.9 Air Quality

A total of 130 tons of nitrogen oxides, 21 tons of sulfur oxides, and 8 tons of particulates would be emitted during any 12 month period of the two-year overlap in construction of the DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration).

3.21.3.10 Agriculture Resources

Future cumulative impacts on agriculture from construction of the DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would include temporary disruption of production on approximately 99.4 acres of grazing and cropland. There would be a cumulative and permanent loss of about 24.5 acres of grazing land and 178.9 acres of cropland. This would cause the following cumulative production decreases during construction: about 1,380 AUMs on grazing land and pasture, 710 bushels of barley and 199 tons of alfalfa. During the two-year overlap in construction of the PRRP Proposed Action (Riverine Habitat Restoration) and DRP With Pipeline Alternative, the cumulative change in production would be a net decrease of 174 AUMs, 199 tons of alfalfa and 710 bushels of barley.

After construction of the PRRP Proposed Action (Riverine Habitat Restoration) and DRP With Pipeline Alternative is completed, they would combine to cause an annual net decrease of 1,359 AUMs and 1 ton of alfalfa.

3.21.3.11 Socioeconomics

The DRP With Pipeline Alternative, PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade would cause a cumulative and peak increase in construction-related employment of approximately 129 jobs. The DRP With Pipeline Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would cause a reduction in gross farm revenues during construction as land is removed from production. The cumulative loss of gross farm revenue would be about $25,000. Gross revenue in the construction and retail trade sectors would increase. The cumulative and peak annual increase in total Wasatch County revenue during construction would be approximately $449,000.

After construction, there would be a cumulative net decrease of about $9,000 in total annual gross revenue in the farm sector of Wasatch County's economy. An increase in retail trade sector revenues of about $179,000 per year would lead to an increase in the county's total gross revenue of approximately $197,000 per year. This would lead to an increase in income, sales tax revenue and income tax revenue. Property tax revenues would drop about $124,000 per year as payments in lieu of taxes from the federal government begin on land that is currently private property.

3.21.3.12 Health and Safety

The DRP With Pipeline Alternative and interrelated projects would cause the same type of potential cumulative impacts on health and safety as described in Section 3.21.2.12. The potential hazards associated with the incremental increase in traffic contributed by this alternative would be smaller than the related hazards caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline).

3.21.3.13 Noise

The same type of cumulative noise impacts described for the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) in Section 3.21.2.13 also would occur under the DRP With Pipeline Alternative and interrelated projects. However, the location of some of the noise impacts of the DRP With Pipeline Alternative would be different than those caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline).

3.21.3.14 Visual Resources

This alternative and interrelated projects would cause the same type of visual impacts described in Section 3.21.2.14, although some of the impacts during construction would occur in different places.

3.21.3.15 Recreation Resources

Cumulative impacts on recreation resources under the DRP With Pipeline Alternative and interrelated projects would be virtually the same as those described in Section 3.21.2.15.

3.21.3.16 Cultural Resources

The discussion in Section 3.21.2.16 also applies to potential cumulative impacts on cultural resources caused by the DRP With Pipeline Alternative and interrelated projects. The DRP With Pipeline Alternative would be constructed in a smaller area than the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), and therefore, the potential for impacts on cultural resources would be more limited.

3.21.3.17 Transportation

Construction of the DRP With Pipeline Alternative and interrelated projects would cause a peak cumulative increase in Highway 40 traffic of approximately 382 daily trips and about 203 daily trips on Highway 189 in Heber Valley. On Highway 189 in the Provo River canyon, the peak cumulative increase in traffic during construction would be about 1,015 trips per day. The SOPs and mitigation included in the Highway 40 and 189 projects would help avoid and minimize adverse cumulative impacts on both highways.

Cumulative traffic impacts during operation of the DRP With Pipeline Alternative and interrelated projects would be the same as the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) described in Section 3.21.2.17.

3.21.4 Cumulative Impacts Caused by the DRP With Canal Alternative and Interrelated Projects

Most of the cumulative impacts caused by the DRP With Canal Alternative and interrelated projects would be the same as those described in Section 3.21.3 for the DRP With Pipeline Alternative. This section only describes those cumulative impacts that would be different under the DRP With Canal Alternative.

3.21.4.1 Mineral and Energy Resources

A total of about 176,100 gallons of fuel would be used during construction of this alternative and the PRRP Proposed Action (Riverine Habitat Restoration). Approximately 84,800 gallons of fuel would be used during the two-year overlap in their construction schedules. About 802,000 kwhr/yr of electricity would be used during operation of the DRP With Canal Alternative.

3.21.4.2 Air Quality

A maximum of 137 tons of nitrogen oxides, 22 tons of sulfur oxides, and 9 tons of particulates would be emitted during any 12 month period of the two-year overlap in construction of the DRP With Canal Alternative and PRRP Proposed Action (Riverine Habitat Restoration).

3.21.4.3 Agriculture Resources

Cumulative agriculture impacts during construction of the DRP With Canal Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would include temporary disruption of production on approximately 53.9 acres of grazing and cropland. There would be a cumulative and permanent loss of about 24.5 acres of grazing land and 182.3 acres of cropland. This would cause the following cumulative production decreases during construction: about 1,320 AUMs on grazing land and pasture, 390 bushels of barley and 126 tons of alfalfa. The cumulative change in production during the two-year overlap in construction of the PRRP Proposed Action (Riverine Habitat Restoration) and DRP With Canal Alternative would be a net decrease of 114 AUMs, 126 tons of alfalfa and 390 bushels of barley.

After their construction, the PRRP Proposed Action (Riverine Habitat Restoration) and DRP With Canal Alternative would combine to cause an annual net decrease of 1,359 AUMs and 271 tons of alfalfa.

3.21.4.4 Socioeconomics

The DRP With Canal Alternative, PRRP Proposed Action (Riverine Habitat Restoration) and Highway 40 upgrade would cause a cumulative and peak increase in construction-related employment of approximately 139 jobs. The DRP With Canal Alternative and PRRP Proposed Action (Riverine Habitat Restoration) would cause a reduction in gross farm revenues during construction as land is removed from production. The cumulative loss of gross farm revenue would be about $19,000. Gross revenue in the construction and retail trade sectors would increase. The cumulative and peak annual increase in total Wasatch County revenue during construction would be approximately $236,000.

After construction, there would be a cumulative net decrease of about $25,000 in total annual gross revenue in the farm sector of Wasatch County's economy. An increase in retail trade sector revenues of about $179,000 per year would lead to an increase in the county's total gross revenue of approximately $181,000 per year. This would lead to an increase in income, sales tax revenue and income tax revenue. Property tax revenues would drop about $108,000 per year as payments in lieu of taxes from the federal government begin on land that is currently private property.

3.21.4.5 Transportation

Construction of the DRP With Canal Alternative and interrelated projects would cause a peak cumulative increase in Highway 40 traffic of approximately 390 daily trips and about 203 daily trips on Highway 189 in Heber Valley. On Highway 189 in the Provo River canyon, the peak cumulative increase in traffic during construction would be about 1,023 daily trips. The SOPs and mitigation included in the Highway 40 and 189 projects would help avoid and minimize adverse cumulative impacts on both highways.

3.22 Irreversible and Irretrievable Commitment of Resources

3.22.1 Introduction

This section describes the irreversible and irretrievable commitment of resources and the potential for conservation that would occur under the Proposed Action (WCWEP With Daniel Replacement Pipeline) and alternatives. (All references to the Proposed Action in this subsection refer to the WCWEP With Daniel Replacement Pipeline.)

There is no irreversible and irretrievable commitment of resources under the Proposed Action and DRP alternatives for the following resources:

- Water resources
- Water quality
- Wetlands
- Aquatic resources
- Wildlife resources
- Threatened and endangered species
- Soil resources
- Air quality
- Health and safety
- Noise
- Visual resources
- Recreation resources
- Transportation

3.22.2 Proposed Action (WCWEP With Daniel Replacement Pipeline)

Materials used during construction of the Proposed Action would be permanently committed to the project. Table 1-20 in Chapter 1, Section 1.12.5 of the WCWEP and DRP EIS lists materials to be used during construction.

There would be an irreversible and irretrievable commitment of mineral and energy resources from construction and operation of the Proposed Action. These commitments consist of the following:

- 56,700 cubic yards of gravel, from an existing off-site borrow source for construction of pump station pads and access and maintenance roads

- 151,600 gallons of fuel for construction and 6,100 gallons a year for operation and maintenance traffic

Increased recreational traffic also would increase fuel consumption, but the amount is not readily quantifiable.

Some existing irrigated and non-irrigated agricultural lands would be permanently removed for construction of canal O&M roads, pumping station pads or regulating ponds (see Table 1-15 in Chapter 1, Section 1.12.1). The acreage of agricultural land permanently removed includes:

- 1.3 acres for canal O&M roads
- 1.0 acre for pumping stations
- 9.2 acres for regulating ponds

Under the Proposed Action, water would be conserved because of more efficient irrigation practices. Some of the conserved water would be committed to provide flows in five local streams in Heber Valley. The remainder of the conserved water would be the source of the Daniel Replacement supply.

Funds used for construction and operation of the Proposed Action would be permanently committed to the project and not be available for other purposes. Table 1-22 in Chapter 1, Section 1.12.7 shows estimated construction and operation costs.

There would be some irreversible and irretrievable commitment of cultural resources. For instance, once the historic integrity of the DIC diversion facilities is compromised, this cultural feature would be lost to future viewing and interpretation.

3.22.3 DRP With Pipeline Alternative

The irreversible and irretrievable commitment of resources under the DRP With Pipeline Alternative would be similar to those in Section 3.22.2 for the Proposed Action. These commitments consist of the following:

- 33,300 cubic yards of gravel

- 42,500 gallons of fuel for construction and 300 gallons a year for operation and maintenance traffic

- 0.3 acres of irrigated agricultural land that would be permanently removed for pumping stations

3.22.4 DRP With Canal Alternative

The irreversible and irretrievable commitment of resources under the DRP With Canal Alternative would be similar to those in Section 3.22.3 for the DRP With Pipeline Alternative. There is some potential for water conservation from decreased conveyance losses, but it is relatively minor because of the limited number of canals that would be converted to pipeline.

Wasatch County Water Efficiency Project and Daniel Replacement Project

Draft Environmental Impact Statement

Chapter 4
Consultation and Coordination

Chapter 4
Consultation and Coordination

4.1 Introduction

This chapter describes the consultation and coordination for the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) Environmental Impact Statement (EIS). It summarizes the scoping process and results of scoping meetings, identifies the agencies and organizations consulted, and describes the coordination that will be achieved in reviewing the Draft EIS (DEIS). Information in this chapter was summarized from the Scoping Summary Report (CUWCD 1995), which is available from Central Utah Water Conservancy District (CUWCD) upon request.

4.2 Scoping Process and Results

The scoping process was conducted by CUWCD to provide the general public, organizations, state and local governments and affected federal agencies an opportunity to identify issues and concerns they believe should be studied early in the preparation of this EIS. "Scoping" is the public involvement process required by the Council on Environmental Quality (CEQ) regulations to help federal agencies determine issues and alternatives analyzed in the EIS. Results of the scoping meetings and comments received during the scoping process were used to establish the scope of the EIS and focus the environmental analysis on important issues and concerns. This section summarizes the pre-scoping and scoping process, describes the results of scoping meetings and how the comments from those meetings were used, and identifies the agencies and organizations consulted.

4.2.1 Pre-scoping and Scoping Process

Pre-scoping public involvement activities were conducted by CUWCD starting in July 1991 to obtain early input on the WCWEP and DRP. They included developing and administering a public survey, forming technical and public advisory committees, and conducting a public involvement meeting and workshop at Wasatch High School in Heber City. Input received from these activities was used to plan the project and contributed to development of a Preliminary Planning Report in February 1993.

The CUWCD held three initial scoping meetings in February 1993 to inform agency representatives, water users, irrigation companies, environmental organizations and the general public about the progress of project planning and to obtain public input on preliminary alternatives and the scope of issues that should be addressed in the EIS. Results of these meetings were used to formulate project alternatives that were refined into a set of definitive alternatives by the technical and public advisory committees. The definitive alternatives were presented to the general public and agencies at two final scoping meetings held in March 1994.

4.2.2 Results of Scoping Meetings and Use of Comments Received

Public input at the scoping meetings and written comments received from interested citizens and organizations were carefully reviewed and analyzed by CUWCD to determine the issues and concerns. The analysis showed the public and agencies placed high priority on the following resources: agriculture, surface water, socioeconomics, wildlife resources, aquatic resources, wetlands and recreation. Resources of moderate importance included threatened and endangered species, water quality, groundwater and health and safety. Issues and concerns about these resources were used to establish the scope of the environmental analysis for this EIS.

The verbal comments made at the scoping meetings and written comments received by the CUWCD were used to identify specific issues and concerns that are addressed in the environmental analysis. These issues and concerns were restated as questions and used to identify impact topics and methodologies for analyzing impacts on the resources. The questions are listed in each resource section and answered by the impact analyses presented in Chapter 3.

4.2.3 Agencies and Organizations Consulted

The following agencies and organizations were consulted during the scoping process. Their level of participation in scoping ranged from attending agency and public meetings to responding with written comments to the CUWCD.

- U.S. Department of the Interior
- U.S. Fish and Wildlife Service (FWS)
- U.S. Department of Agriculture, Forest Service-Uinta National Forest (USFS)
- U.S. Department of Agriculture, Soil Conservation Service (SCS) (now called Natural Resources Conservation Service (NRCS)
- U.S. Environmental Protection Agency (EPA)
- U.S. Army Corps of Engineers (COE)
- U.S. Bureau of Reclamation (USBR)
- Utah Department of Natural Resources (UDNR)
- Utah Division of Wildlife Resources
- Utah Division of Water Resources
- Utah Division of Water Rights
- Utah Division of Parks and Recreation
- Utah Department of Environmental Quality (DEQ), Division of Water Quality
- Utah State Engineer
- Wasatch County Special Service Area (WCSSA)
- Wasatch Soil Conservation District (SCD)
- Wasatch County Commission
- Salt Lake County Water Conservancy District (SLCWCD)
- Utah Outdoor Interests Coordinating Council (UOICC)
- Trout Unlimited
- Salt Lake County Fish and Game Association
- Stonefly Society
- Sierra Club
- Utah Wildlife Board
- High Country Flyfishers
- Wasatch County Water Users
- Provo River Water Users Association (PRWUA)
- Utah Lake Water Users

Representatives of these agencies and organizations made verbal comments at one or more scoping meetings or submitted written comments to CUWCD after scoping meetings, which helped identify issues and concerns about resources. Their comments were used to establish the scope of the environmental analysis.

4.3 Consultation

This section describes coordination highlights and significant consultation by CUWCD with agencies, organizations and technical experts throughout the environmental analysis and preparation of the EIS. Related studies required by law or executive order and integrated with this EIS are described at the end of this section.

4.3.1 Agencies, Organizations and Technical Experts Consulted

The following subsections describe the significant consultation during development of the Proposed Action and the EIS.

4.3.1.1 Provo/Wasatch Planning Coordination Committee. This committee first met on January 21, 1992 to begin project planning that evolved into the WCWEP and DRP. Its purpose was to bring together the diverse interests of federal, state and local agencies, water users, local elected officials and interested organizations to discuss how the provisions of the Central Utah Project Completion Act (CUPCA) could be met in Heber Valley. The committee continued its meetings on: February 6, 1992; April 2, 1992; April 8, 1992; May 5, 1992; and toured Heber Valley on September 29, 1993 and October 22, 1993. The following agencies and organizations and their representatives participated in the committee:

- FWS — Leon Colborn, Bob Freeman, Reed Harris
- EPA — Dave Ruiter, Wes Wilson
- COE — Katherine Trott
- USFS — Walt Hanks, Bob Hurley, Jim Percy, Robert Riddle

- NRCS — Todd Nielson, Marilyn O'Dell
- USBR — Bruce Barrett, Boyd Clark, David Frandsen, Rex Gabbitas, Jay Henrie, Fred Liljegren, Don Olsen, Bruce Snyder, Lee Swensen
- Utah Division of Wildlife Resources — John Fairchild, Mark Holden, Doug Sakaguchi, Charles Thompson
- UDNR — Milo Barney
- Utah Division of Water Resources — Robert King
- Utah Division of Water Rights — Chad Gourley, Bob Morgan, Jim Riley, Jerry Olds
- Utah Division of Parks and Recreation — T.E. Green, Willy Yu
- Utah DEQ — Rick James
- Wasatch County Commission — Morroni Besendorfer
- Wasatch County — Bob Mathis
- SLCWCD — Tage Flint
- UOICC — Jeffrey Appel, Paul Dremann, Dan Potts
- PRWUA — Jack Gardner, Richard Poulsen
- Wasatch County Water Users — Cal Muir

4.3.1.2 Wasatch County Water Efficiency Study Advisory Committee. This committee held its first meeting on January 14, 1992 to advise CUWCD on specific local and regional needs for the Wasatch County Water Efficiency Study, which led to formulation of the WCWEP and DRP. A second meeting was held on April 30, 1992. The following agencies and organizations and their representatives participated in the committee:

- USBR — David Frandsen
- U.S. Geological Survey (USGS) — D. Michael Roark
- Utah Division of Water Rights — Bob Morgan
- Wasatch County Commission — Morroni Besendorfer
- Wasatch County — Bob Mathis
- Midway City — Reed Bezzant
- Provo City — Merril Bingham
- Provo River Canals Commission — Robert Fillerup
- Metropolitan Water District of Salt Lake City — Nick Sefakis
- SLCWCD — David Ovard
- UOICC — Jeffrey Appel, Paul Dremann, Dan Potts
- PRWUA — Jack Gardner, Richard Poulsen
- Utah Lake Water Users — Charles Wilson
- Summit County Water Users — Ed Ure

4.3.1.3 Irrigation Water Delivery Requirements Technical Committee. This committee first met on June 23, 1992 to discuss how irrigation water delivery requirements would be met throughout Heber Valley under the study that evolved into the WCWEP and DRP. A second meeting was held on April 8, 1993. The following agencies and organizations and their representatives participated in the committee:

- USBR — David Frandsen
- NRCS — Jan Anderson, Ralph Mickelson, Neil Murray
- Utah Division of Water Rights — Jerry Olds
- Wasatch SCD — Claude Hicken, Jack Young
- Wasatch County — LeeRoy Farrell, Cal Muir
- Utah State University Extension — Steven Cox, Robert Hill, D.W. James, Val Warnick

4.3.1.4 Groundwater and Return Flow Technical Committee. This committee met once on June 2, 1993 to discuss groundwater and return flow in Heber Valley and their effects on downstream water users, which is related to distribution of water under the WCWEP and DRP. The following agencies and organizations and their representatives participated in the committee:

- USBR — Jay Henrie
- NRCS — Jan Anderson
- USGS — Jeff Freethey
- UDNR — Milo Barney
- Utah Division of Water Resources — Robert King
- Wasatch SCD — Claude Hicken, Jack Young
- Provo City — Carl Carpenter, Bart Simons
- City of Orem — Bruce Chesnut
- Utah State University Extension — Steven Cox, Robert Hill, D.W. James, Val Warnick

4.3.1.5 Fishery Technical Committee. This committee first met on March 3, 1992 to develop a field work plan for Heber Valley and upper Strawberry River basin streams. The committee continued meeting to review results of field data collection and analysis, and identify streams that would be candidates for receiving supplemental instream flows under the WCWEP and DRP. The committee held additional meetings on the following dates: March 31, 1992; May 6, 1992; May 27, 1992; June 2, 1992; May 24, 1993; September 1, 1993; February 17, 1994; March 21, 1994; March 29, 1994; and May 26, 1994. The following agencies and organizations and their representatives participated in the committee:

- FWS — Leon Colborn
- COE — Katherine Trott
- USFS — Barbara Franano, Walt Hanks, Bob Hurley, Juan Spillet
- NRCS — Jan Anderson, Ralph Mickelson, Marilyn O'Dell, Robert Sennett
- Utah Division of Wildlife Resources — John Fairchild, Mark Holden, Doug Sakaguchi, Charles Thompson
- UDNR — Milo Barney
- Utah Division of Water Rights — Chad Gourley
- Utah Division of Parks and Recreation — T.E. Green
- Wasatch SCD — Claude Hicken, Jack Young
- WCSSA — LeeRoy Farrell
- Wasatch County Commission — Morroni Besendorfer
- Wasatch County — Kenley Brunsdale, Bob Mathis
- Midway City — John Anderson
- Midway Irrigation Company — Britt Mathwich, Elmer Wilson
- UOICC — Jeffrey Appel, Paul Dremann, Darrell Mensel, Dan Potts
- Wasatch County Water Users — George Holmes

4.3.1.6 Instream Flow Work Group. This work group was a subcommittee of the Fishery Technical Committee that was charged with determining which Heber Valley streams would receive supplemental instream flows under the WCWEP and DRP, how much flow each stream would receive, and prioritizing the streams for instream flows. The work group first met on April 14, 1994 and held additional meetings on April 25, 1994; May 5, 1994; May 17, 1994; and January 10, 1995. The following agencies and organizations and their representatives participated in the committee:

- FWS — Leon Colborn
- NRCS — Jan Anderson
- Utah Division of Wildlife Resources — John Fairchild, Mark Holden, Doug Sakaguchi, Charles Thompson
- UDNR — Milo Barney
- Wasatch SCD — Jack Young
- WCSSA — LeeRoy Farrell
- Wasatch County Commission — Morroni Besendorfer
- UOICC — Paul Dremann, Dan Potts

4.3.1.7 Wetlands Technical Committee. This committee first met on October 23, 1991 to discuss how wetlands in Heber Valley would be potentially affected by the project that evolved into the WCWEP and DRP. They developed and reviewed field study plans, evaluated data collected on wetland communities, recommended against converting the North Fields area from flood irrigation to protect the wetlands, and held preliminary discussions regarding mitigation for wetland impacts. The following additional meetings were held with the Wetlands Technical Committee: February 13, 1992; March 31, 1992; April 8, 1992; April 21, 1992; May 28, 1992; May 24, 1993; June 25, 1993; October 13, 1994; November 2, 1994; and February 8, 1995. The following agencies and organizations and their representatives participated in the committee:

- FWS — Leon Colborn, Bob Freeman
- COE — Brooks Carter, Katherine Trott, Michele Waltz
- USBR — Bruce Barrett, David Frandsen, Jay Henrie, Richard Jensen, Jonathan Jones, Christine Karas, Steven Lloyd, Bruce Moore, Barry Wirth
- EPA — Dave Ruiter
- USFS — Walt Hanks, Bob Hurley
- NRCS — Jan Anderson, Jana Johnston, Marilyn O'Dell, Robert Sennett
- Utah Division of Wildlife Resources — Larry Dalton, John Fairchild, Mark Holden, Catharine Quinn, Doug Sakaguchi, Charles Thompson
- UDNR — Milo Barney
- Utah Division of Water Rights — Chad Gourley
- Utah Division of Parks and Recreation — T.E. Green, Willy Yu
- Wasatch SCD — Jack Young
- WCSSA — LeeRoy Farrell

- Wasatch County Commission — Morroni Besendorfer
- Wasatch County — Kenley Brunsdale, Bob Mathis
- Midway City — John Anderson
- Midway Irrigation Company — Britt Mathwich, Elmer Wilson
- UOICC — Jeffrey Appel
- SLCWCD — Jeff Bryant
- Wasatch County Water Users — George Holmes

4.3.1.8 Water Quality Technical Committee. This committee first met on July 27, 1993 to discuss water quality aspects of the WCWEP and DRP and the types of analyses that should be included in the EIS. Some committee members are on the Jordanelle Technical Advisory Committee (JTAC), which was formed by USBR to monitor water quality changes associated with construction and operation of Jordanelle Dam and Reservoir. The Water Quality Technical Committee held additional meetings on April 14, 1994; April 28, 1994; and January 11, 1995. The following agencies and organizations and their representatives participated in the committee:

- USBR — David Frandsen
- NRCS — Jan Anderson, Ralph Mickelson
- Utah Division of Wildlife Resources — Doug Sakaguchi
- Utah Division of Water Quality — Harry Lewis Judd
- Utah DEQ — Mike Reichert
- Wasatch SCD — Claude Hicken
- WCSSA — LeeRoy Farrell
- Wasatch County — Dennis Jensen, Bob Mathis
- Mountainland Association of Governments — Ray Loveless

4.3.1.9 Tri-Valley Watershed Plan Consultation. CUWCD held consultation meetings with the Natural Resources Conservation Service (NRCS) (previously called SCS) on the Tri-Valley Watershed Plan. The first meeting was held on March 21, 1994 to discuss how the WCWEP and DRP and Tri-Valley Watershed Plan are interdependent. Environmental analysis plans, work scopes and schedules were shared between the CUWCD and NRCS. Additional consultation meetings were held with the NRCS on April 21, 1994; September 13, 1994; October 13, 1994; and March 28, 1995. The following agencies and organizations and their representatives participated in these meetings:

- NRCS — Jan Anderson, Jana Johnston, Ralph Mickelson, Todd Nielson, Marilyn O'Dell, Robert Rasely, Robert Sennett, Art Shoemaker
- Utah Division of Wildlife Resources — John Fairchild, Doug Sakaguchi
- Wasatch SCD — Claude Hicken, Jack Young
- Mountainland Association of Governments — Ray Loveless

4.3.1.10 Upper Strawberry River Basin Consultation. CUWCD held consultation meetings with the USFS Heber Ranger District on the plan to abandon and remove Daniel Irrigation Company diversion facilities in the upper Strawberry River basin. The first meeting was held on August 10, 1994 to review the alternatives assessed by the USFS and discuss data analyses for recreation, cultural and aquatic resources. Additional consultation meetings were held with the USFS on October 3, 1994; October 18, 1994; November 15, 1994; February 8, 1995; and March 13, 1995. During these meetings, modifications to the plan were discussed and the environmental analyses were reviewed. The following USFS representatives participated in the consultation meetings:

- Dave Christensen
- Barbara Franano
- Julie Jensen
- Bevan Killpack
- Deanna Nelson
- Jim Percy
- Charmaine Thompson
- Brett Wiese

4.3.1.11 Work Plan Reviews. Work plans were prepared by CUWCD for each resource analyzed in Chapter 3 of this EIS. Each work plan identified specific issues and concerns, impact topics, impact analysis methodology, significance criteria, data sources, dependency items with other resources, and included a Chapter 3 section outline. These work plans were distributed to agencies and organizations in July and August 1994 for review, comment and concurrence before CUWCD started the environmental analysis on any resource. The following agencies, organizations and their representatives received work plans for review as indicated:

- Department of the Interior (Ron Johnston) — all resources
- FWS (Leon Colborn) — Aquatic Resources, Threatened and Endangered (T&E) Species, Vegetation, Wetlands, Wildlife, Water Quality, Water Resources
- COE (Michele Waltz) — Aquatic Resources, Vegetation, Wetlands, Wildlife, Water Quality, Water Resources
- NRCS (Jan Anderson) — Agriculture, Soils, Vegetation, Wetlands, Water Quality, Water Resources
- EPA (Wes Wilson) — Air Quality, Health and Safety, Vegetation, Wetlands, Water Quality, Water Resources
- USFS (Bevan Killpack) — all resources
- Utah Division of Wildlife Resources (Milo Barney, Mark Holden) — Aquatic Resources, T&E Species, Vegetation, Wetlands, Wildlife, Water Quality, Water Resources
- Utah Division of Water Resources (Robert King) — Water Quality, Water Resources
- Utah Division of Water Quality (Mike Reichert) — Water Quality, Water Resources
- WCSSA (LeeRoy Farrell) — Agriculture, Soils, Vegetation, Wetlands, Water Quality, Water Resources
- UOICC (Jeffrey Appel) — all resources

4.3.1.12 Chapter 1 PDEIS Agency Review. Chapter 1 of the Preliminary Draft EIS (PDEIS) was distributed to agencies and organizations by CUWCD in July 1995 for review and comment. The purpose of this early review was to help the agencies and organizations and their representatives understand the Proposed Action and alternatives for the WCWEP and DRP EIS as they reviewed the technical reports. A meeting was held on August 2, 1995 to present Chapter 1 and answer agency questions. A Chapter 1 agency and organization comment meeting was held on August 15, 1995. Written comments submitted to the CUWCD after the meeting were combined with verbal comments and incorporated into Chapter 1. The following agencies, organizations and their representatives participated in the Chapter 1 review:

- Department of the Interior — Ron Johnston, Reed Murray, Ralph Swanson
- FWS — Robert Benton, Leon Colborn, Lucy Jordan
- NRCS — Jan Anderson, Ralph Mickelson, Marilyn O'Dell
- USFS — Bevan Killpack, Deanna Nelson
- EPA — Wes Wilson
- COE — Michele Waltz
- Utah Reclamation Mitigation and Conservation Commission — Mark Holden
- Utah Division of Water Resources — Milo Barney, Norm Stauffer
- Utah Division of Water Rights — Ben Anderson
- Utah Division of Wildlife Resources — Doug Sakaguchi
- Wasatch SCD — Jack Young
- WCSSA — LeeRoy Farrell
- Wasatch County — Dan Matthews, Cal Muir
- UOICC — Jeffrey Appel

4.3.1.13 Technical Report Reviews and Consultation Meetings. Technical report reviews and consultation were conducted in a two-stage process. Pre-technical report meetings were held on August 2, 1995 for Water Resources and Water Quality, and on August 9, 1995 for Wetlands, Aquatic Resources and T&E Species. These meetings provided the agencies and organizations an opportunity to preview the content and key results of each report before it was released for review. Technical reports were distributed by CUWCD to agencies and organizations in October, November and December 1995 for review and comment. About two weeks after each technical report was distributed, CUWCD held a meeting to receive verbal comments, which were transcribed and sent to the agencies and organizations for concurrence. Written comments were received on technical reports about two weeks after the technical report meetings. Technical report comment meetings were held on November 6, 1995 (Water Resources); December 13, 1995 (Water Quality and Wetlands); and December 21, 1995 (Aquatic Resources and T&E Species).

The following agencies and organizations and their representatives participated in technical report reviews and consultation meetings:

- Department of the Interior — Reed Murray

- FWS — Leon Colborn
- NRCS — Jan Anderson, Ralph Mickelson, Marilyn O'Dell, Robert Sennett
- USFS — Bevan Killpack
- COE — Michele Waltz
- Utah Division of Water Resources — Milo Barney
- Utah Reclamation Mitigation and Conservation Commission — Mark Holden
- Utah Division of Wildlife Resources — Gary Ogborn, Doug Sakaguchi
- Wasatch SCD — Jack Young
- WCSSA — LeeRoy Farrell
- UOICC — Jeffrey Appel

4.3.1.14 PDEIS Agency Review. The PDEIS was distributed to cooperating agencies and organizations by CUWCD on March 1, 1996 for review and comment. The CUWCD requested the cooperating agencies and organizations to submit formal written comment on the PDEIS by March 27, 1996. Comments on the PDEIS received from the cooperating agencies and organizations were used to prepare the Draft EIS. The following cooperating agencies and organizations participated in the PDEIS review:

- U.S. Department of the Interior
- U.S. Fish and Wildlife Service
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of Agriculture, Forest Service-Uinta National Forest
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- Utah Reclamation Mitigation and Conservation Commission
- Utah Department of Natural Resources
- Utah Division of Wildlife Resources
- Utah Division of Water Resources
- Utah Division of Water Rights
- Wasatch County Special Service Area No. 1
- Utah Outdoor Interests Coordinating Council

4.3.2 Related Studies

Related studies required by law or executive order have been prepared and integrated with this EIS. The following sections briefly review these studies.

4.3.2.1 Fish and Wildlife Coordination Act. CUWCD has consulted with the FWS on fish and wildlife resources and habitats that would be affected by the WCWEP and DRP. Consultation meetings were held with FWS on September 20, 1994, October 6, 1994, and March 13, 1995 to discuss requirements for Biological Assessments and the schedule to complete the Fish and Wildlife Coordination Act Report. The FWS is preparing a Planning Aid Memorandum to comply with requirements of the Fish and Wildlife Coordination Act.

4.3.2.2 Endangered Species Act of 1973. CUWCD has consulted with the FWS on T&E species and received a list of species in the impact area of influence. CUWCD prepared a draft Biological Assessment for the WCWEP and DRP, which was submitted to the FWS for review and comment. CUWCD has prepared a final Biological Assessment and submitted it to the FWS. The FWS will prepare a Biological Opinion.

4.3.2.3 National Historic Preservation Act. CUWCD has consulted with the State Historic Preservation Office (SHPO) on cultural resources that could be affected by the WCWEP and DRP. A Programmatic Memorandum of Agreement (PMOA) has been developed and is in the process of being signed by CUWCD, Department of the Interior, Mitigation Commission, USFS, Utah SHPO and the Advisory Council on Historic Preservation authorizing the plan for survey, collection and documentation of cultural resources that would be affected by construction of the WCWEP and DRP. A Draft Cultural Resources Technical Report (CUWCD 1996f) was prepared as a support document to this EIS and is available from CUWCD upon request.

4.3.2.4 Clean Air Act. An air quality analysis has been conducted and integrated with this EIS (see Section 3.10 of the WCWEP and DRP EIS).

4.3.2.5 Executive Order 11988, Floodplain Management. Protection of floodplains and their management has been included in the environmental analysis and integrated with this EIS (see Section 3.2 of the WCWEP and DRP EIS).

4.3.2.6 Safe Drinking Water Act and Clean Water Act of 1977. A detailed water quality analysis has been conducted and integrated with this EIS (see Section 3.3 of the WCWEP and DRP EIS).

4.3.2.7 Executive Order 11990, Protection of Wetlands. A detailed wetlands analysis has been conducted and integrated with this EIS (see Section 3.4 of the WCWEP and DRP EIS).

4.4 Coordination

This section describes the coordination that will be achieved in reviewing the Draft EIS (DEIS). A complete mailing list of all agencies, bureaus, organizations, groups and individuals that will receive the DEIS is available upon request from:

Karen Ricks, Project Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058-7303

4.4.1 Request for Official Comments

The following agencies, bureaus, groups and organizations will receive the DEIS for review:

- U.S. Department of the Interior
- U.S. Fish and Wildlife Service
- U.S. Department of Agriculture, Forest Service-Uinta National Forest
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- Utah Department of Natural Resources
- Utah Division of Wildlife Resources
- Utah Division of Water Resources
- Utah Division of Water Rights
- Utah Division of Parks and Recreation
- Utah Department of Environmental Quality, Division of Water Quality
- Utah State Engineer
- Wasatch County Special Service Area
- Wasatch County
- Wasatch Soil Conservation District
- Wasatch County Commission
- Salt Lake County Water Conservancy District
- Utah Outdoor Interests Coordinating Council
- Trout Unlimited
- Salt Lake County Fish and Game Association
- Stonefly Society
- Sierra Club
- Utah Wildlife Board
- High Country Flyfishers
- Wasatch County Water Users
- Provo River Water Users Association
- Utah Lake Water Users
- Private individuals who have requested a copy

4.4.2 Public Hearings

Two public hearings will be held on the DEIS — one in Heber City and the other in Salt Lake City. Following are the hearing dates, times and locations:

Heber City DEIS Hearing

Date: July 16, 1996
Time: 6:00 p.m.
Location: Wasatch County Middle School
800 S. 200 E.
Heber City, Utah

Salt Lake City DEIS Hearing

Date: July 17, 1996
Time: 6:30 p.m.
Location: Salt Lake County Commission Chambers
2001 S. State Street
Salt Lake City, Utah

A public hearings registration form follows Appendix C.

Provo River Restoration Project

Utah Reclamation Mitigation and Conservation Commission (Lead Agency)
U.S. Department of the Interior (Joint Lead Agency)

Draft Environmental Impact Statement

Utah Reclamation
Mitigation and
Conservation
Commission

MARCH 3, 1849

June 1996

COVER SHEET

Provo River Restoration Project (PRRP)

(X) Draft ( ) Final

Joint Lead Agencies

Utah Reclamation Mitigation and Conservation Commission
U.S. Department of the Interior

Cooperating Agencies

U.S. Department of Army, Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Department of Agriculture, Forest Service
Utah Department of Natural Resources
Central Utah Water Conservancy District
Wasatch County Special Service Area No. 1

Counties that Could be Affected

Wasatch, UT

Abstract

This Draft Environmental Impact Statement (DEIS) covers the Provo River Restoration Project (PRRP). The Proposed Action (Riverine Habitat Restoration) would reconstruct and realign a majority of the existing Provo River channel and floodplain system (between Jordanelle Dam and Deer Creek Reservoir) in a meandering riffle-pool sequence to re-create a naturally functioning river channel contiguous with the floodplain in dynamic equilibrium with the current valley and hydrologic conditions. Side channels and ponds would be constructed on both sides of the new river alignment to provide diversity and unique habitat features. One alternative (Existing Channel Modification) would modify the existing channel using a step-pool sequence to control water velocity and stabilize stream banks. Another alternative (Instream Structures) would install instream fish habitat structures at selected locations along the Provo River. Neither of these alternatives would involve major channel realignment. The No Action Alternative would not stabilize the river bed and banks, restore riverine habitat and improve fish habitat. Major environmental issues involve water resources, wetlands, aquatic resources, wildlife, threatened and endangered species, agriculture, socioeconomics and recreation resources.

Other Requirements Served

This DEIS is intended to serve other environmental review and consultation requirements pursuant to 40 CFR 1502.25 (a).

DEIS Contact

Comments on this DEIS should be directed to:

Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission
355 West 1300 South
Orem, UT 84058-7303

Date DEIS Made Available to EPA and the Public:

June 10, 1996

MC DES–96–01

Date by which Comments on the DEIS Must be Received to Be Considered in the Preparation of the Final Environmental Impact Statement:

August 13, 1996

UTAH RECLAMATION MITIGATION AND CONSERVATION COMMISSION

DRAFT
ENVIRONMENTAL IMPACT STATEMENT ON THE PROVO RIVER RESTORATION PROJECT

Prepared by
Utah Reclamation Mitigation and Conservation Commission
June 1996

Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission

Ronald Johnston, CUPCA Program Director
U.S. Department of the Interior

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*Are included in map pocket at back of EIS

Summary

The following sections summarize each chapter of the Provo River Restoration Project (PRRP) Environmental Impact Statement (EIS). This summary describes the purpose and need, major differences for key resources between the impacts of the Proposed Action and alternatives, major impact conclusions of the EIS and key consultation and coordination activities. This summary also describes areas of controversy or concern and issues to be resolved.

S.1 Chapter 1 – Description of the Proposed Action and Alternatives

S.1.1 Need for the Proposed Action and Alternatives

The following needs would be met by the Proposed Action and alternatives:

- Meet requirements for partial mitigation of impacts caused by the Central Utah Project (CUP), as specifically defined in the 1988 Definite Plan Report for the Bonneville Unit of the CUP (USBR 1988); the 1988 Aquatic Mitigation Plan for the Strawberry Aqueduct and Collection System of the Bonneville Unit of the CUP (USBR 1988); and Title III of CUPCA (Section 303(d), Sections 307(1), 307(2), 309(a)(1), 309(a)(4), and 311(d)(2).
- Restore or improve the Provo River between Jordanelle Dam and Deer Creek Reservoir to a more naturally functioning riverine ecosystem. The Provo River has been extensively modified by man's activities, including impoundment, water diversions, channel straightening, dredging and diking. These actions have resulted in degradation of the natural features and functions of the riverine ecosystem, including loss of habitat for fish and wildlife, altered vegetative communities and sediment transport and deposition patterns within the historic floodplain and river channel.

Measures to improve fish and riparian habitat and natural functions of the Provo River ecosystem are required as partial mitigation for past impacts of the CUP on this and other reaches of the Provo River and to other streams within the Bonneville Unit area. The Provo River Project, a USBR project constructed in the 1940s and 1950s, drastically altered the Provo River both upstream and downstream of the present Jordanelle Reservoir. The 1979 EIS and 1987 Supplement to the Final EIS for the Municipal and Industrial System (USBR 1979 and 1987) required acquisition of public angler access to this reach of the Provo River, and maintenance of minimum instream flows of 125 cubic feet per second (cfs). These commitments have not been implemented, but are included in the baseline conditions of this EIS as further described in Chapter 3. CUPCA authorizes additional measures to rehabilitate riparian habitats and restore fish habitat on the Provo River between Jordanelle Dam and Deer Creek Reservoir.

S.1.2 Purposes of the Proposed Action and Alternatives

The alternatives described and compared in this EIS are designed to meet the needs for this project. Following are the specific purposes of the Proposed Action and alternatives:

- To help mitigate the environmental impacts of the Bonneville Unit of the CUP and the Provo River Project on riverine environments
- To increase biological productivity and diversity within the Provo River ecosystem
- To restore and improve fish habitat in the Provo River
- To create a diversity of wetland and aquatic habitats within the Provo River corridor
- To rehabilitate riparian habitat, including cottonwood galleries and wetlands
- To assure that adjustments are made to the public access corridor acquired under baseline conditions for recreational angling and related activities if required by the Proposed Action or alternatives

- To assure that public access, as provided under baseline conditions, continues if modified by the PRRP
- To achieve a state of dynamic equilibrium between the River channel, its floodplain, its sediment and its water supply
- To accommodate a growing, statewide demand for stream-related outdoor recreation experiences

S.1.3 Description of the Proposed Action and Alternatives

The baseline for the PRRP is not the same as existing conditions. Existing conditions are constantly changing because of factors beyond the control of this project. However, this document considers those changes that are expected to occur by the year 2000 as part of the baseline, if they are federal CUP-related commitments or requirements. These commitments include requirements of the Final Supplement to the Final Environmental Statement for the M&I System (USBR 1987) for providing seven new recreation access points (including parking areas and sanitary facilities); providing fishing access (by foot only) through land acquisition along the entire Provo River corridor between Jordanelle Dam and the inlet to Deer Creek Reservoir; fencing of the public access corridor; and maintaining a minimum instream flow of 125 cfs in the same reach of the Provo River. Modifications to some existing diversions in the Provo River will be required to pass the 125 cfs minimum instream flow. The width of the public access corridor would basically be the area between the outside edge of the existing dikes, or an area extending about 50 feet beyond the existing channel banks in undiked sections of the river. These commitments will be implemented regardless of a decision to implement the PRRP described in this EIS. The impacts of the previous commitments defined above, which become part of the baseline for this DEIS, were documented in the previously referenced EIS. Therefore, those impacts are not included in the analysis of the Proposed Action or its alternatives.

S.1.3.1 The Proposed Action (Riverine Habitat Restoration)

Map A-5 (see pocket at back of EIS) shows the location of the major physical features of the Proposed Action It includes reconstructing and realigning most of the existing river channel and floodplain system in a meandering riffle-pool sequence to re-create a naturally functioning river channel contiguous with the floodplain in dynamic equilibrium with the current valley and hydrologic conditions. Existing levees would be removed and 100-year flood protection would be provided by the expanded floodplain or new setback levees. A meandering riffle-pool channel interacting with a functioning floodplain would be developed wherever possible. In some areas, this would be accomplished by incorporating the present channel. In others, the present channel would be abandoned and a new channel alignment developed. Where possible, the river channel would be allowed to adjust within a designated corridor in response to changing hydrologic or geomorphic factors. Disturbed areas along the new floodplain would be revegetated with indigenous plants. The new floodplain would be subject to flooding once every 2 years and once every 5 years with velocities capable of scouring surface soils; these conditions are necessary conditions for natural regeneration of cottonwood trees and other riparian vegetation.

Side channels and ponds would be constructed on both sides of the new river alignment under the Proposed Action throughout the length of the Provo River corridor between Jordanelle Dam and Deer Creek Reservoir. These would create diverse habitat conditions which would be suitable habitat for spawning and rearing of fishes, especially non-game fishes and other aquatic amphibian species. The side channels would be developed as small meandering channels adjacent to the Provo River. The ponds would be constructed in the side channels. Water would be diverted from the Provo River into the side channels, flow into the ponds, continue flowing from the ponds down the side channels and return to the river. Final locations and dimensions of ponds and side channels would be determined at the final design stage.

S.1.3.2 Existing Channel Modification Alternative

Map A-6 (located in pocket at back of EIS) shows the location of the major physical features of the Existing Channel Modification Alternative. This alternative would reconstruct the river cross-section geometry within the present channel alignment to create a functional step-pool or rapid-pool system. It would attempt to stabilize the existing river channel by making channel modifications with multiple rock weirs and large boulders. Disturbed areas along the existing channel would be revegetated with indigenous plants.

S.1.3.3 Instream Structures Alternative

The Instream Structures Alternative would install instream fish habitat structures at selected locations along the Provo River making no significant changes to the existing river channel geometry and elevations. The structures would attempt to provide geomorphic diversity and improve habitat conditions, primarily for trout.

S.1.3.4 No Action Alternative

The No Action Alternative would not involve any changes to the current river alignment or other baseline conditions (see Section S.1.1. for a description of the major baseline parameters). The Aquatic Mitigation Plan for the SACS would have to be revised.

S.2 Chapter 2 – Comparative Analysis of the Proposed Action and Alternatives

This section summarizes the major differences among the impacts of the Proposed Action and Existing Channel Modification and Instream Structures alternatives, which involve the aquatic resources, wetlands, wildlife, agriculture, socioeconomics and recreation resources.

The No Action Alternative would not involve any changes to the current river alignment or other baseline conditions. Restoration of the Provo River between Jordanelle Dam and Deer Creek Reservoir would not occur. None of the positive impacts associated with the Proposed Action or any of the other PRRP alternatives would occur if the No Action Alternative was implemented.

S.2.1 Aquatic Resources

The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would all enhance aquatic species habitat and trout populations in the Provo River. The Proposed Action would cause the greatest improvement in aquatic species habitat. It would increase trout populations nearly 3.5 times the increase under the Existing Channel Modification Alternative, and almost 12 times the increase under the Instream Structures Alternative. Only the Proposed Action would include construction of side channels, which would benefit both game and non-game species, including the leatherside chub (a species of special concern that may be listed under the Endangered Species Act).

S.2.2 Wetlands

The Proposed Action and Existing Channel Modification Alternative would cause impacts to riparian woodland, shrub wetlands, wet and moist meadow wetlands and emergent marshes. Many of these wetland impacts would occur on agricultural fields and pastures with low wetland functional value. In some cases wetlands with higher wetland values would be impacted such as those in the northern reaches of the project area. Incremental increases in wetland acreage would occur under either the Proposed Action or Existing Channel Modification Alternative as the project is constructed and begins to function as a natural riverine system. The wetland and riparian habitat created under the Proposed Action would be more than twice the amount created under the Existing Channel Modification Alternative. The Instream Structures Alternative would only cause minor disturbances to wetlands during construction and no net increase to wetlands as a result of the project.

S.2.3 Wildlife Resources

The Proposed Action would cause a net increase of 218.3 acres of wildlife habitat and permanently protect an additional 114.7 acres of undeveloped and existing wildlife habitat that is vulnerable to development. The Existing Channel Modification Alternative would case a net increase of 78.8 acres of wildlife habitat. Approximately 1,216 cottonwood trees would be removed during construction of the Proposed Action compared to 1,080 during construction of the Existing Channel Enhancement Alternative. New cottonwoods would be planted, and natural cottonwood regeneration would occur on the floodplain. These trees would take about 15 to 30 years to reach a height and size comparable to those removed.

S.2.4 Agriculture

The Proposed Action and Existing Channel Modification Alternative would cause temporary and permanent impacts on agricultural land along the Provo River. The amount of land affected by the Proposed Action would be much larger, and thus the production losses during and after construction would be higher. Pasture and grazing land production would be reduced by 52.6 percent during construction and 50.0 percent annually after construction under the Proposed Action. The corresponding reduction in production for the Existing Channel Modification Alternative would be 2.2 percent during construction and 2.1 percent after construction. The Instream Structures Alternative would cause a very small reduction in production during construction (0.2 percent) and no impacts after construction.

S.2.5 Socioeconomics

Construction of the Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would increase gross revenue, income and employment in the construction and retail trade sectors of the local economy and decrease agricultural revenue, especially under the Proposed Action. The positive economic impacts caused by the Proposed Action and alternatives, as measured by total gross revenue in Wasatch County, would outweigh the decreases in the revenue in the agricultural sector they cause. This is true both during and after construction.

S.2.6 Recreation Resources

The increase in trout populations and other improvements to the Provo River ecosystem would increase recreation use in the corridor over the long term. Since increased recreation use would be in proportion to increased trout populations, the Proposed Action would attract the most recreationists, while the Instream Structures Alternative would attract the least.

S.3 Chapter 3 – Affected Environment and Environmental Consequences

S.3.1 Areas of Controversy or Concern

This section summarizes the major areas of controversy or issues of concern identified by the public or agencies during scoping, or by the EIS team during the analysis.

S.3.1.1 Water Resources

- What impacts would the PRRP have on reducing peak flow rates from Jordanelle Reservoir during the summer months?

S.3.1.2 Wetlands

- How would construction of the PRRP impact wetlands?
- How would changes in the groundwater table impact wetlands?

S.3.1.3 Aquatic Resources

- What opportunities would the Proposed Action and alternatives have for developing side channels to benefit fish spawning and rearing?

- What would be the impacts on fish, fish habitat and other aquatic resources from the PRRP?

S.3.1.4 Wildlife Resources

- What would be the potential impacts of construction on wildlife and their habitat?

S.3.1.5 Threatened and Endangered Species

- What impacts would the Proposed Action and alternatives have on spotted frogs, Ute ladies'-tresses and bald eagles?

S.3.1.6 Agriculture

- Would land reclaimed by filling the old river channel under the Proposed Action be covered with sufficient topsoil to conduct farming activities? Could this reclaimed land be used by farmers and ranchers with adjacent property?

- What impacts would the PRRP have on farming operations that would be divided by the Proposed Action? How would irrigation water be provided to both sides of the river where a farm is presently on one side of the river?

- What impacts would occur on livestock crossing and watering on private land under the PRRP?

- What impacts would the PRRP have on land owner access to farms divided by the Proposed Action? Would river crossings be provided to access divided farmlands?

- What would be the impacts of restrictions on motorized equipment crossing the river, and how would these impacts be mitigated to accommodate existing access by farmers and ranchers?

- How would increased public access along the river affect farming activities?

- What impacts would improvement of threatened and endangered species habitats along the river have on future agricultural uses?

S.3.1.7 Socioeconomics

- What social, emotional and economic impacts would occur to property owners along the river from people trespassing, potential loss of private land by acquisition, providing public access, and an influx of people pursuing recreational activities?

- How would the county tax base be affected by converting arable lands to a more sinuous river channel?

- What economic impacts would be incurred by private land owners along the river from acquisition of land for the Proposed Action and alternatives?

- What probable economic impacts would new recreation and resource users have on Heber Valley?

S.3.1.8 Recreation Resources

- What would be the recreational capacity of the river under the PRRP?

- What impacts would increased recreational use by fishermen, hikers, bikers, joggers and others have on highly sensitive areas along the river?

S.3.2 Major Impact Conclusions

S.3.2.1 Water Resources

The Proposed Action would increase surface water travel time by an average of 1 hour for flows from Jordanelle to Deer Creek Reservoir because of the longer channel and slower flow velocities. The Existing Channel Modification and Instream Structures alternatives would increase water travel time by an average of about 12 minutes. The Proposed Action could increase groundwater levels by about 1 to 3 feet in the northern portion of the valley adjacent to the river depending on the final design elevation of the invert of the river channel. These groundwater level increases would be associated with changes in the grade and length of the river channel, which affects the surface area and seepage interaction between the river and groundwater basin.

S.3.2.2 Wetlands

The Proposed Action and Existing Channel Modification Alternative would increase riparian woodland, wet meadow, emergent marsh and shrub wetlands along the Provo River. Construction procedures under the Proposed Action would directly impact 24.7 acres of wet meadow, emergent marsh and shrub wetlands, but all would be restored under Standard Operating Procedures (SOPs). Construction of the Proposed Action would permanently remove 74.2 acres of wetland and 1,216 cottonwood trees. About 292.5 acres of wetland and riparian habitat would be developed under the Proposed Action. The Existing Channel Modification Alternative would permanently remove a total of 63.1 acres of wetland and 1,080 cottonwood trees, and would create 141.9 acres of riparian habitat, which also would develop over 3 to

30 years on the channel banks and about half of the new 2-year floodplain. The Instream Structures Alternative would have no measurable impacts on wetlands.

S.3.2.3 Aquatic Resources

The Proposed Action and Existing Channel Modification and Instream Structures alternatives would increase trout biomass in the Provo River between Jordanelle Dam and Deer Creek Reservoir and also benefit non-game fish and other aquatic resources. In each case, it would take about 15 to 20 years to reach the predicted level of trout standing crop described below. The Proposed Action would increase trout biomass by about 25,754 pounds a year, or 491 percent. It also would increase aquatic habitat surface area by 15.6 acres, or 17 percent, compared to baseline conditions because of the longer channel length and side channels incorporated into the floodplain. The Existing Channel Modification Alternative would increase trout biomass by about 7,906 pounds per year, or 151 percent, and would decrease aquatic habitat surface area by 17.9 acres, or 20 percent, compared to baseline conditions. The Instream Structures Alternative would increase trout biomass by about 3,077 pounds a year, or 59 percent, and would not change aquatic habitat surface area from baseline conditions.

S.3.2.4 Wildlife Resources

Construction of the Proposed Action and Existing Channel Modification and Instream Structures alternatives would temporarily disturb game and non-game wildlife species, but mule deer fawning areas would be avoided. The Proposed Action would cause a net increase of 218.3 acres of riparian and wetland wildlife habitat, which would develop over 2 to 30 years depending on habitat type. The Existing Channel Modification Alternative would cause a net increase of 78.8 acres of riparian and wetland wildlife habitat, which would develop over 2 to 30 years depending on habitat type. The Instream Structures Alternative would not change the area of wildlife habitat.

S.3.2.5 Threatened and Endangered Species

The Proposed Action would temporarily disturb 22.2 acres of spotted frog habitat during construction, which would be restored by SOPs. It would permanently remove 55.2 acres of spotted frog habitat, which would be offset by creation and enhancement of 90.9 acres of open water, emergent marsh and wet meadow by restoring natural functions to the riparian corridor. The Existing Channel Modification Alternative would temporarily disturb 100.9 acres of spotted frog habitat, which would be restored by SOPs. This alternative would permanently remove 22.9 acres of spotted frog habitat. Conservation measures would be used to avoid taking of this species during construction. A long-term monitoring plan is proposed to monitor potential impacts related to indirect impacts of the Proposed Action. The Proposed Action and Existing Channel Modification Alternative would fully replace Ute ladies'-tresses habitat that would be removed during construction. The Proposed Action and Existing Channel Modification Alternative would have long-term beneficial effects on Ute ladies'-tresses habitat because of the development of a floodplain with periodic scouring and sediment deposition. The Proposed Action would increase the habitat for peregrine falcon prey, and bald eagles would benefit from increased trout populations and more roosting habitat.

S.3.2.6 Agriculture

The Proposed Action and Existing Channel Modification Alternative would decrease grazing land and irrigated pasture animal unit months (AUM). The Proposed Action would cause a loss of 1,266 AUMs during construction and 1,203 AUMs annually after construction. The Existing Channel Modification Alternative would cause a loss of 54 AUMs during construction and 49 AUMs annually after construction. Realignment of the Provo River channel would cause adverse and significant impacts on some agricultural practices and operations, including more difficult crossings of the Provo River, modifications to irrigation systems as side channels dissect irrigated fields, and alterations to cultivation practices. While related impacts on farm revenue would be minor from a regional perspective, the economic impacts on individual operations could be more significant.

S.3.2.7 Socioeconomics

Construction of the Proposed Action and Existing Channel Modification and Instream Structures alternatives would increase gross revenue, income and employment in the construction and retail trade sectors of the local economy. During construction, the Proposed Action would cause a decrease of about $8,862 in agricultural gross revenue, but an increase of $561,000, or less than 1 percent, in total Wasatch County income revenue and income in Wasatch County's retail trade sector would increase as recreationists spend money in the valley on their way to fish in the Provo River. The total increase in gross revenue for Wasatch County after construction would be about $85,000 a year (less than 1 percent of total Wasatch County revenue). The Existing Channel Modification Alternative would increase total Wasatch County revenue by $84,000 (less than 1 percent) during construction. The total increase in gross revenue after construction would be about $26,000 a year (less than 1 percent of total Wasatch County revenue). The Instream Structures Alternative would increase total Wasatch County revenue by $84,000 (less than 1 percent) during construction. The total increase in gross revenue after construction would be about $8,000 a year (less than 1 percent of total Wasatch County revenue). The Proposed Action and alternatives would not induce growth in Heber Valley or elsewhere. The possibility of the implementation of the Proposed Action or any of the alternatives has raised considerable concern among the various social groups e.g. ranchers, residing in Heber Valley. They have expressed concern (during the scoping meetings, meetings with the Special Service District Board of Directors, meetings with individual land owners, and in newspaper articles) about the potential disruption of the current rural, ranching lifestyle prevalent in this part of Heber Valley. The disruptions and changes would be caused by the acquisition of private land and changes in land use that would occur.

S.3.2.8 Recreation Resources

Recreational opportunities would increase significantly over baseline conditions along the Provo River under the Proposed Action and Existing Channel Modification and Instream Structures alternatives. The Proposed Action would increase recreational fishing by 9,240 angler days a year, or 662 percent. The Existing Channel Modification Alternative would increase recreational fishing by 2,836 angler days a year, or 251 percent. The Instream Structures Alternative would increase recreational fishing by 1,104 angler days per year, or 159 percent.

S.3.3 Issues to be Resolved

This section defines issues that need to be resolved. The related sections of the EIS will be modified accordingly as these issues are resolved.

S.3.3.1 Wetlands

Wetlands temporarily impacted by the Proposed Action and alternatives would be restored by SOPs. The Wetlands analysis also concluded that the amount and quality of riparian wetlands created by the Proposed Action and Existing Channel Modification Alternative would be greater than those affected along the Provo River. Therefore, mitigation has not been proposed for these impacts. Mitigation has been proposed for impacts on USBR mitigation wetlands and wet meadow wetlands. The conclusions of the wetlands analysis need to be reviewed and approved by the reviewing agencies, especially the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency.

S.4 Chapter 4 – Consultation and Coordination

The CUWCD conducted extensive consultation and coordination while preparing this EIS and performing related environmental and planning studies. Pre-scoping and scoping consultations were held with the public, agencies and organizations. Less formal consultations with agencies, organizations and technical experts took place throughout the preparation of the EIS.

The EIS scoping process included consultations with 29 agencies and organizations as well as 260 members of the general public. The concerns voiced by people at district workshops were incorporated into the Preliminary Planning Report in February 1993. Additional comments received at scoping meetings in February 1993 and in March 1994 and others received in writing after the meetings were analyzed and used to finalize the alternatives and scope of the EIS. A Scoping Summary Report (CUWCD 1995) identified the following resource topics as the most important to the public, agencies and organizations that participated in scoping: agriculture, surface water, socioeconomics, wildlife resources, aquatic resources, wetlands and recreation. Resource topics identified as moderately important included threatened and endangered species, water quality, groundwater and health and safety.

Additional consultation and coordination occurred during the preparation of the EIS, and early planning studies. The following committees provided valuable input and helped reach important decisions:

- Provo River Technical Committee (composed of 26 agencies, organizations and invited technical experts)
- Provo/Wasatch Planning Coordination Committee (composed of 18 agencies and organizations)
- Fishery Technical Committee (composed of 16 agencies and organizations)
- Wetlands Technical Committee (composed of 19 agencies and organizations)
- Water Quality Technical Committee (composed of 9 agencies and organizations)

Draft work plans prepared for each resource topic addressed in the EIS were reviewed by 11 agencies and organizations and their comments incorporated into final work plans distributed in July and August 1994.

Chapter 1 of the Preliminary Draft Environmental Impact Statement was distributed to 14 agencies and organizations in July 1995 for early review and comment so they and their representatives would better understand the Proposed Action and alternatives as they reviewed the EIS technical reports.

Draft EIS technical reports were distributed to 11 agencies and organizations for comments, and meetings held to receive verbal comments. These meetings were held in October, November and December 1995 and additional comments were received in writing after the meetings.

Future consultation and coordination will include soliciting and incorporating comments on the Draft Environmental Impact Statement (DEIS), and public hearings on the DEIS. The remainder of the EIS process will continue to emphasize close consultation and coordination with agencies, organizations and the public.

Provo River Restoration Project

Draft Environmental Impact Statement

Chapter 1
Description of the Proposed Action and Alternatives

Chapter 1
Description of the Proposed Action and Alternatives

1.1 Introduction

The Provo River Restoration Project (PRRP) proposes to make modifications to the shape, slope and alignment of the Provo River between Jordanelle Dam and Deer Creek Reservoir. The objective of the modifications is to create a more naturally functioning river system, and thereby enhance biological productivity and diversity of the fish habitat, riparian, and other environmental resources in the river corridor. The PRRP would provide public angler access to the realigned portion of the river that falls outside of the baseline public access corridor.

The primary purpose of Chapter 1 is to define the PRRP Proposed Action and alternatives. This chapter also defines the purpose of and need for the project and provides other background information.

Planning and initial design studies for the PRRP to date have been completed by the Central Utah Water Conservancy District (CUWCD), with funding provided by the U.S. Bureau of Reclamation (USBR) and the Utah Reclamation and Mitigation Conservation Commission (Mitigation Commission). The PRRP EIS analyzes three alternatives that fulfill the Mitigation Commission's obligations under the Central Utah Project Completion Act (CUPCA) to improve and restore the fish and riparian habitats of the Provo River between Jordanelle Dam and Deer Creek Reservoir. Decision-making authority regarding a Proposed Action and specific project elements of the PRRP resides with the Mitigation Commission.

The material presented in this chapter describing the Proposed Action (Riverine Habitat Restoration) (referred to in the PRRP Technical Report (CUWCD 1994a) as the Maximum Practical Restoration Alternative) and the Existing Channel Modification Alternative (referred to in the PRRP Technical Report (CUWCD 1994a) as the Existing Channel Enhancement Alternative) has been prepared and summarized from the Provo River Restoration Project Technical Report — Description of Proposed Alternatives (CUWCD 1994a). This report is available upon request from:

Karen Ricks, Project Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058-7303

The description of the Instream Structures Alternative was summarized from the Aquatic Habitat Improvement Plan for the Provo River below Jordanelle Dam, Utah (Clearwater BioStudies, Inc. 1991). A summary of the Instream Structures Alternative is presented in the PRRP Technical Report (CUWCD 1994a).

The PRRP Environmental Impact Statement (EIS) has been prepared based upon feasibility level designs of the Proposed Action and alternatives. No other distinctly different alternatives have been identified for the PRRP EIS. Final designs for the Proposed Action or selected PRRP alternative would be prepared after the EIS is finalized and prior to construction. Construction of the PRRP would proceed on a reach-by-reach basis.

This chapter makes frequent reference to the accompanying Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) EIS for supporting information. Text and tables are not repeated if they are contained in the WCWEP and DRP EIS.

1.2 Purpose and Need

This section describes the need and purposes that the Proposed Action and alternatives are responding to. Section 1.2.1 lists the need for the Proposed Action and alternatives and Section 1.2.2 lists their purposes.

1.2.1 Need for the Proposed Action and Alternatives

The following needs would be met by the Proposed Action and alternatives:

- Meet requirements for partial mitigation of impacts caused by the Central Utah Project (CUP), as specifically defined in the 1988

Definite Plan Report for the Bonneville Unit of the CUP (USBR 1988b); the 1988 Aquatic Mitigation Plan for the Strawberry Aqueduct and Collection System of the Bonneville Unit of the CUP (USBR 1988b); and Title III of CUPCA (Section 303(d), Sections 307(1), 307(2), 309(a)(1), 309(a)(4), and 311(d)(2).

- Restore or improve the Provo River between Jordanelle Dam and Deer Creek Reservoir to a more naturally functioning riverine ecosystem. The Provo River has been extensively modified by man's activities, including impoundment, water diversions, channel straightening, dredging and diking. These actions have resulted in degradation of the natural features and functions of the riverine ecosystem, including loss of habitat for fish and wildlife, altered vegetative communities and sediment transport and deposition patterns within the historic floodplain and river channel.

Measures to improve fish and riparian habitat and natural functions of the Provo River ecosystem are required as partial mitigation for past impacts of the CUP on this and other reaches of the Provo River and to other streams within the Bonneville Unit area. The Provo River Project, a USBR project constructed in the 1940s and 1950s, drastically altered the Provo River both upstream and downstream of the present Jordanelle Reservoir. The 1979 EIS and 1987 Supplement to the Final EIS for the Municipal and Industrial System (USBR 1979 and 1987) required acquisition of public angler access to this reach of the Provo River, and maintenance of minimum instream flows of 125 cubic feet per second (cfs). These commitments have not been implemented, but are included in the baseline conditions of this EIS as further described in Chapter 3, Section 3. CUPCA authorized additional measures to rehabilitate riparian habitats and restore fish habitat on the Provo River between Jordanelle Dam and Deer Creek Reservoir.

1.2.2 Purposes of the Proposed Action and Alternatives

The alternatives described in this EIS are designed to meet the needs for this project. Following are the specific purposes of the Proposed Action and alternatives:

- To help mitigate the environmental impacts of the Bonneville Unit of the CUP and the Provo River Project on riverine environments
- To increase biological productivity and diversity within the Provo River ecosystem
- To restore or improve fish habitat in the Provo River
- To create a diversity of wetland and aquatic habitats within the Provo River corridor
- To rehabilitate riparian habitat, including cottonwood galleries and wetlands
- To make adjustments to the public access corridor acquired under baseline conditions for recreational angling and related activities as required by the Proposed Action and alternatives
- To achieve a state of dynamic equilibrium between the River channel, its floodplain, its sediment and its water supply
- To accommodate a growing, statewide demand for stream-related outdoor recreation experiences

1.3 Overview of the Proposed Action and Alternatives

This section summarizes the features of the Proposed Action and alternatives. Sections 1.7 through 1.11 describe the Proposed Action and alternatives in more detail.

Commitments made in the Final Supplement to the Final Environmental Statement for the Municipal and Industrial System (USBR 1987) will cause changes in the existing environment. These commitments include providing seven new recreation access points (including parking and sanitary facilities); providing fishing access (by foot only) through land acquisition along the entire Provo River corridor between Jordanelle Dam and the inlet to Deer Creek Reservoir; fencing of the public access corridor; and maintaining a minimum instream flow of 125 cfs in the Provo River, which would require modifications to some existing diversions. The width of the public access corridor would basically be the area between the outside edge of the existing dikes, or an area extending about 50 feet beyond the existing channel banks in undiked sections of the river. These commitments will be implemented regardless of a decision to implement the PRRP Proposed Action or any of the alternatives. Implementation of these commitments forms the baseline conditions used in determining the potential impacts of the Proposed Action and the alternatives.

1.3.1 Location of the Proposed Action and Alternatives

Map 1-1 illustrates the location of the Proposed Action and alternatives in Heber Valley situated between Jordanelle Dam and Deer Creek Reservoir. The Provo River flows approximately 10 miles from Jordanelle Dam at the north end of Heber Valley to Deer Creek Reservoir at the south end of the valley. The north and upstream PRRP boundary is the Old US 40 bridge about 1,300 feet downstream of Jordanelle Dam. The south and downstream PRRP boundary is the State Route 113 bridge crossing the upper end of the Deer Creek Reservoir flood easement area. Elevations along this portion of the river range from 5,860 to 5,410 feet mean sea level. The east and west boundaries of the PRRP are generally within 1,000 feet of the existing river channel, and at no point exceed 1,400 feet from the present channel. Maps A-5 and A-6 in the map pocket at the back of the EIS provide more specific information about the location of the Proposed Action and alternatives.

Map 1-1 and Maps A-5 and A-6 in the map pocket at the back of the EIS show the nine reaches (river segments) into which the Provo River was divided for planning and environmental analysis purposes. Subsequent discussions of the Proposed Action and alternatives make frequent reference to the river reach designations shown on these maps.

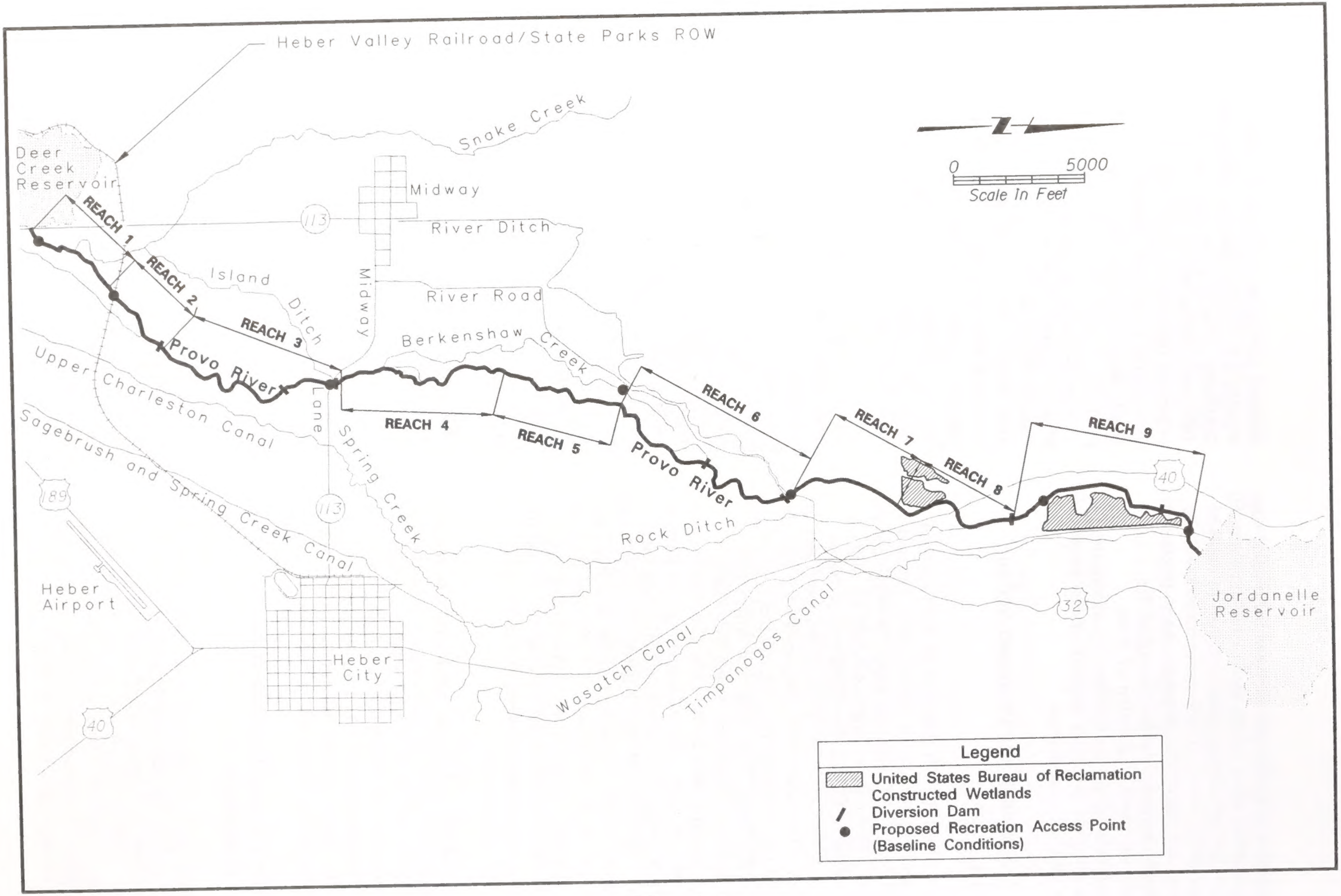
1.3.2 The Proposed Action: Riverine Habitat Restoration

The location of the major physical features of the Proposed Action (Riverine Habitat Restoration) are shown on Map A-5 in the map pocket at the back of the EIS. The Proposed Action would reconstruct and realign a majority of the existing river channel and floodplain system in a meandering riffle-pool sequence to recreate a naturally functioning river channel contiguous with the floodplain in dynamic equilibrium with the current valley and hydrologic conditions. Existing levees would be removed and 100-year flood protection would be provided by the expanded floodplain or new setback levees. A meandering riffle-pool channel interacting with a functioning floodplain would be developed wherever possible. In some areas, this would be accomplished by incorporating the present channel. In others, the present channel would be abandoned and a new channel alignment developed. Where possible, the river channel would be allowed to adjust its alignment within the designed meander width in response to changing hydrologic or geomorphic factors. Disturbed areas along the new floodplain would be revegetated with indigenous species using artificial and natural means.

Side channels and ponds would be constructed on either side of the new river alignment under the Proposed Action throughout the length of the Provo River corridor between Jordanelle Dam and Deer Creek Reservoir. These features would add significant habitat diversity to the project. The side channels would be developed as small meandering channels adjacent to the Provo River. The ponds would be constructed in the side channels. Pond and side channel features currently shown in the Proposed Action are conceptual. Exact numbers, locations and dimensions will be determined at the final design stage. Water would be diverted from the Provo River into the side channels, flow into the ponds, continue flowing from the ponds down the side channels and return back to the river.

1.3.3 Existing Channel Modification Alternative

The location of the major physical features of the Existing Channel Modification Alternative are shown on Map A-6 in the map pocket at the back of the EIS. The Existing Channel Modification Alternative would reconstruct the river cross-section geometry within the present channel alignment to create a functional step-pool or rapid-pool system. This alternative would attempt to stabilize the existing river channel by making channel modifications with multiple rock weirs and large boulders. It would essentially create a canyon-type stream in a valley setting. Disturbed areas along the existing channel would be revegetated with indigenous species.



Map 1–1
Location of the Proposed Action and Alternatives

1.3.4 Instream Structures Alternative

The Instream Structures Alternative would make minor changes to the existing river channel geometry and elevations through installation of instream fish habitat structures at selected locations along the Provo River. Map 1-2 shows the locations where instream structures would be installed in the main channel under the Instream Structures Alternative. (Note: This alternative is referred to as the No Action Alternative in the PRRP Technical Report (CUWCD 1994a).)

1.3.5 No Action Alternative

The No Action Alternative is the alternative of not stabilizing the river bed and banks, not restoring the riverine habitat and not improving instream fish habitat. The commitments included in the Bonneville Unit Municipal and Industrial (M&I) System EISs would be implemented and cause impacts under baseline conditions. Their effects would continue under the No Action Alternative. Dike and river diversion maintenance for flood control and irrigation would continue in and near the Provo River channel.

1.3.6 Major Differences Between the Proposed Action and Alternatives

Table 1-1 summarizes the key characteristics of the Proposed Action and PRRP alternatives. The Proposed Action and Existing Channel Modification Alternative would both make major changes to the existing channel in order to develop a self-sustaining, functional river system. One primary difference is that the Existing Channel Modification Alternative would work almost entirely within the present leveed area or present channel alignment, whereas the Proposed Action would not be constrained to the present alignment. The Existing Channel Modification Alternative would construct a step-pool B-type channel and not increase the length of the river. The Proposed Action would result in development of a meandering riffle-pool C-type channel and increase the sinuosity and length of the river. (Channel Types B and C are based on the Rosgen Stream Classification System and are described in Sections 1.7 and 1.8 of this EIS and in the PRRP Technical Report (CUWCD 1994a).) Another primary difference is that the Proposed Action would encourage the development of a diverse riparian zone with cottonwood trees and other riparian vegetation sustained by periodic flooding of the constructed floodplain. The Existing Channel Modification Alternative would have a narrow riparian zone along the river channel. It also would use setback dikes more extensively to establish future 100-year flood limits as opposed to allowing these limits to be set by natural topographic features as in the Proposed Action. Figure 1-1 shows schematics of typical river cross-sections for the Proposed Action and Existing Channel Modification Alternative.

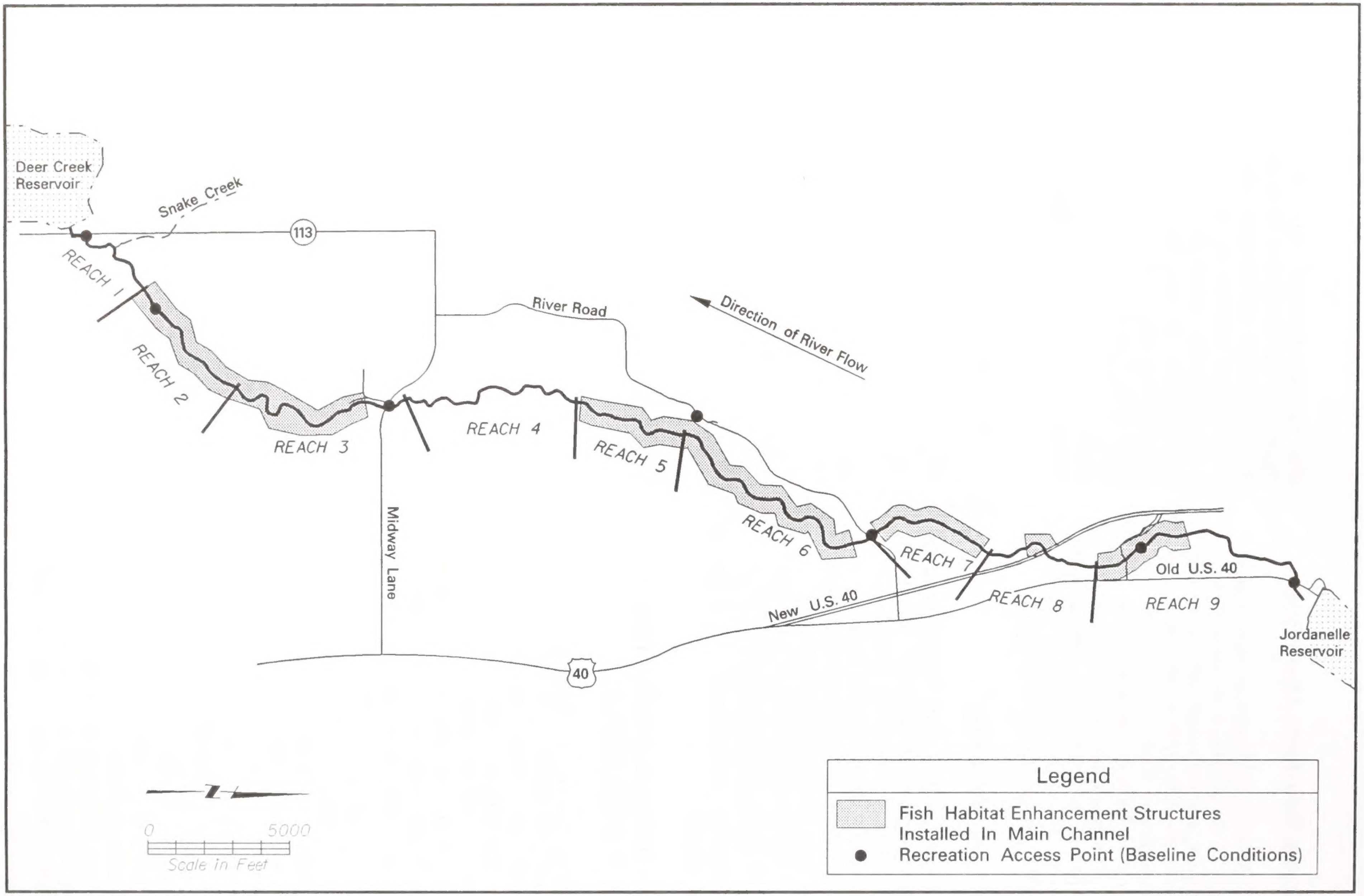
The Instream Structures Alternative is different from the Proposed Action because it would not make major changes to the existing channel. This alternative would make minor changes within the existing Provo River channel through installation of fish habitat structures.

The Proposed Action and alternatives were formulated with the same assumed hydrology, based on proposed water releases from Jordanelle Dam. This includes the 125 cfs minimum streamflow requirement as mandated in Section 303 (c)(2) of CUPCA. PRRP design hydrology is summarized in the PRRP Technical Report. Hydrologic characteristics and public access to the entire existing river corridor are assumed to be part of baseline conditions.

1.4 History and Background

1.4.1 Statutory Background

CUPCA (Public Law 102-575) created the Mitigation Commission to coordinate implementation of fish, wildlife and recreation mitigation and conservation measures for the CUP and other federal reclamation projects in Utah. CUPCA specifically directs the Mitigation Commission to implement, on a priority basis, unfulfilled mitigation commitments of past CUP decision documents, most of which are specifically identified in the 1988 Definite Plan Report for the Bonneville Unit of the CUP. CUPCA provides further guidance regarding standards that the Mitigation Commission must consider and apply while developing its five-year Mitigation and Conservation Plan. Specifically, Section 301 (g)(4) of CUPCA directs the Mitigation Commission to



Map 1–2
Instream Structures Alternative

Table 1-1
Key Characteristics of the Proposed Action and PRRP Alternatives*

Page 1 of 3

Characteristic	Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Main Channel Activities	Construct 70-100 ft wide meandering riffle-pool channel; Remove or breach nearly all dikes; establish 400+ ft wide floodplain; Regrade channel profile to fit natural features. Restore 11.6 miles of river; Increase existing river length by 10,540 feet. Remove 47,800 ft of existing levee	Reconstruct 65-80 ft wide rapid-pool and step-pool channel in existing channel alignment; Construct 140-180 ft wide floodplain, within existing dikes where possible, or within new setback dikes; Minimal adjustments to thalweg elevation, except where diversion dams are removed. Modify 9.6 miles of river; Remove or breach 21,500 ft of existing levee; No increase in river length	Install over 200 habitat enhancement structures (logs, boulders, root wads) in 5.9 miles of river; Make no other changes to channel system. Enhance 5.9 miles of river; No increase in river length
Floodplain Activities	Construct **55,400** ft of side channels; Construct **eight** floodplain ponds; Raise or lower 47 acres to develop needed channel-floodplain	None	None
Channel Stability	Excellent dynamic stability conditions because of adherence to geomorphic design for riffle-pool channels; Riffles designed to hold grade; Additional bank protection used where necessary	Good static stability conditions through armoring of riffles and bank revetment; Attention to riffle design to hold grades and prevent excessive sediment production	Minor, localized, short-term improvement in vertical stability; Horizontal stability fixed by dikes; Geomorphic problems remain
Flood Control	Construct 16,100 ft of 2 ft to 3 ft high setback dikes to control flooding	Construction of 17,800 ft of setback dikes	No flood control changes

Table 1-1
Key Characteristics of the Proposed Action and PRRP Alternatives*

Page 2 of 3

Characteristic	Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Revegetation	Revegetation methods would be applied to new channel/floodplain corridor to assure stability; All disturbed areas would be revegetated, reseeded or enhanced by natural recruitment	Revegetation methods would be applied to new channel/floodplain corridor to assure stability; All disturbed areas would be revegetated, reseeded or enhanced by natural recruitment	No revegetation activities would occur as part of project
Irrigation Diversions	Remove all diversion dams (10) to fit stable channel slope; Reconstruct all diversions and relocate four diversion points to match new channel grades	Remove all diversion dams (10) to fit stable channel slope; Reconstruct all diversions to match new channel grades; Relocate Probst and Baum Diversion points	No modifications to irrigation diversions
Access	Acquire public access on non-public parcels along new river corridor; Acquire construction easement where needed (181 acres); Acquire additional flood easement of 121 acres	Acquire construction easement where needed. Minor increase in flood easement width (2 locations)	None
Transportation	Protect 7 existing bridges; rebuild 2 private bridges No relocation/reconstruction of existing paved roads	Protect 9 existing bridges (4 private) No relocation/reconstruction of existing paved roads	Protect 9 existing bridges (4 private) No relocation/reconstruction of existing paved roads

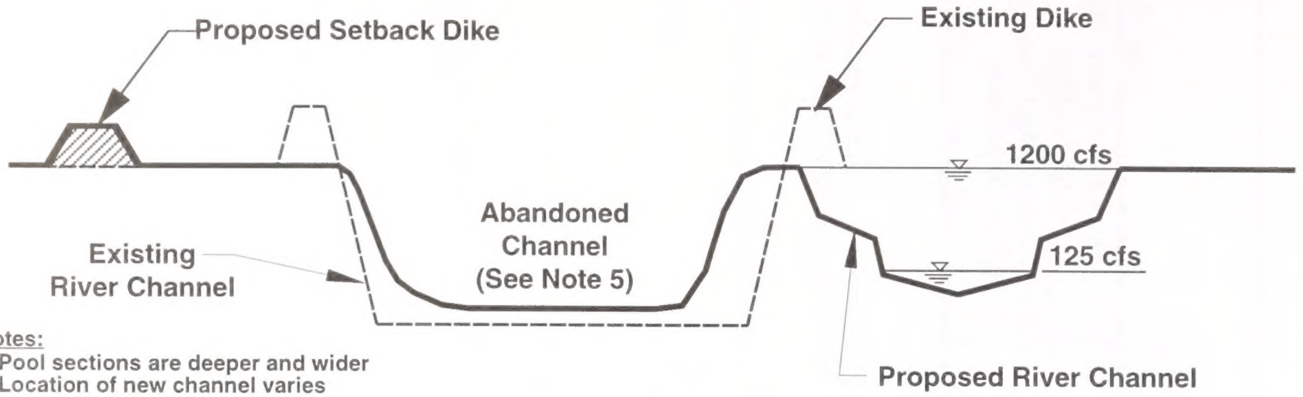
Table 1-1
Key Characteristics of the Proposed Action and PRRP Alternatives*

Page 3 of 3

Characteristic	Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Utilities	Cross 6 utility facilities Relocate 2 utility facilities	Cross 6 utility facilities No utility relocations	Cross 6 utility facilities No utility relocations

Notes:

*The No Action Alternative would not change any characteristics of the Provo River. Baseline conditions would continue including seven recreation access points, contiguous access to the river corridor for recreational angling, and a minimum instream flow of 125 cfs.

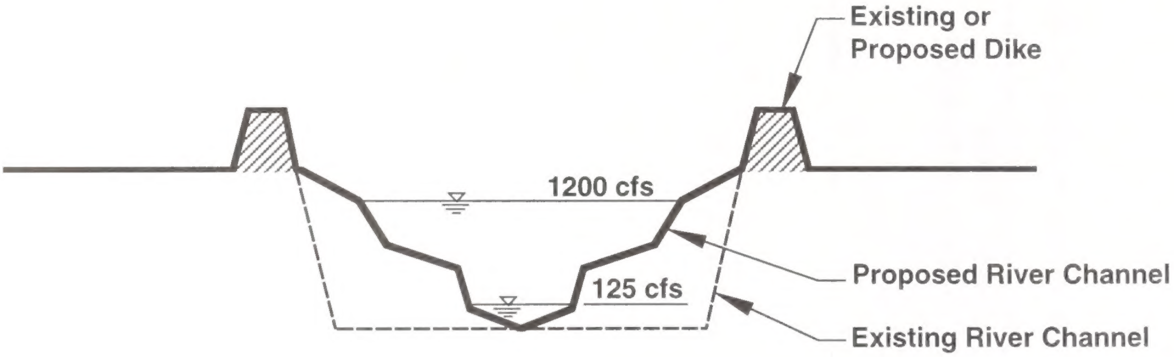


Notes:

1. Pool sections are deeper and wider
2. Location of new channel varies across floodplain
3. Setback dikes required in some locations to contain 100-year discharge
4. Existing dikes retained in some locations
5. Existing channel can be filled or retained for wetland development

Cross-Section View of
Proposed Action
(Riverine Habitat Restoration)
(Riffle Section)

Scale:
1 in. = 50 ft Horizontal
1 in. = 10 ft Vertical



Notes:

1. Pool sections are deeper and wider
2. In some locations, dikes are relocated to setback positions within existing easements
3. Dikes contain 100-year discharge

Cross-Section View of
Existing Channel Modification Alternative
(Riffle Section)

Scale:
1 in. = 50 ft Horizontal
1 in. = 10 ft Vertical

Figure 1-1
Schematic of Typical River Cross-Section

implement projects that it determines will meet the following standards:

> "(A) restore, maintain, or enhance the biological productivity and diversity of natural ecosystems within the State and which have substantial potential for providing fish, wildlife, and recreation mitigation and conservation opportunities;
>
> (B) be based on, and supported by, the best available scientific knowledge;
>
> (C) utilize, where equally effective alternative means of achieving the same sound biological or recreational objectives exist, the alternative that will also provide public benefits through multiple resource uses;
>
> (D) complement the existing and future activities of the Federal and State fish, wildlife, and recreation agencies and appropriate Indian tribes;
>
> (E) utilize, when available, cooperative agreements and partnerships with private landowners and nonprofit conservation organizations; and
>
> (F) be consistent with the legal rights of appropriate Indian tribes."

The Mitigation Commission has adopted a Planning Rule (43 CFR, Part 10005) that establishes more specific criteria for evaluating projects and meeting the standards listed above.

1.4.2 Project Approach and History

As described in Section 1.2, the PRRP would help mitigate the fish, wildlife and environmental impacts of the Bonneville Unit of the CUP. The 1988 Aquatic Mitigation Plan for the Strawberry Aqueduct and Collection System provided specific recommendations for fish habitat improvement measures, including the Provo River between Jordanelle Dam and Deer Creek Reservoir. These improvements would be made only on streams with public access and where activities or forces that have destabilized streambanks and limited fish habitat have been controlled. The baseline conditions for the PRRP partially satisfy these conditions by including the acquisition of public angler access to and along the river and by providing minimum instream flows of 125 cfs. Prior to baseline, reaches of the Provo River had been dewatered during the irrigation season, which eliminated fish habitat during those times. A plan to implement the fish habitat improvements was developed (the Instream Structures Alternative in this EIS) but never implemented. Two additional alternatives developed to meet this need are analyzed in this document. The history of the development of the three PRRP alternatives is described below.

The PRRP has evolved from efforts over the past several years by CUWCD and more recently the Mitigation Commission to investigate approaches for improving the overall value of the Provo River corridor from Jordanelle Dam to Deer Creek Reservoir. These approaches were investigated as alternatives to accomplish the Bonneville Unit mitigation requirements, with the same overall objective of meeting the need for this action in this reach of the Provo River. The following outlines the overall implementation program:

- Conceptual Study (completed 1992)
- Technical Report/Feasibility Study (completed 1994)
- Environmental Impact Study (present document)
- Issue Record of Decision
- Final Design
- Apply for required permits
- Management Plan
- Construction
- Maintenance and Monitoring

The PRRP Technical Report, which provides supporting information for the EIS, was sponsored by CUWCD under the Provo River/Utah Lake Special Studies Program. Funding was provided by USBR as part of its mitigation responsibilities. The Technical Report incorporates the recommendations of the "Aquatic Habitat Improvement Plan for the Provo River below Jordanelle Dam," prepared by Clearwater BioStudies, Inc. (1991) as they pertain to the Instream Structures Alternative.

1.4.3 Provo River History

In recent geologic history the Provo River in Heber Valley can be described as a multiple-channel system, characterized by shifting channel alignments. Historical photographs show that a broad area of dense riparian vegetation (cottonwoods, willows, etc.) once dominated Heber Valley, extending over a width of 1,000 feet or more.

The current character of the river is primarily the result of man's influences during the past 100 years. These influences are associated with the following activities:

- Transbasin diversions to the Provo River watershed from the Weber River and Duschene River basins (imported water greatly increases the flow and erosion potential in the river during high runoff and flood periods)
- Channelization, dredging and construction of dikes along the majority of the study reach to control flooding and channel migration (the straightened and confined channel has little habitat diversity, and the bottom in some locations has downcut from erosion)
- Construction of hard sills or dams at points of irrigation diversions (these cause the channel to widen upstream and downcut immediately downstream)
- Diversion of channel flows to satisfy irrigation water rights (these diversions completely dewater portions of the channel during parts of the year)
- Clearing and filling of abandoned floodplain areas for agriculture, grazing and municipal development

1.5 Authorizing Actions, Permits and Licenses

This section defines the actions, permits and licenses needed to construct and maintain the PRRP. Table 1-2 defines these authorizing actions and includes information concerning the types of actions, agencies responsible for each action and the related project features.

1.6 Interrelated Actions

This section describes projects that could cause cumulative impacts with the PRRP. These projects are referred to as interrelated projects. The definition of cumulative impacts and the process used to identify interrelated projects are described in Chapter 1, Section 1.7 of the WCWEP and DRP EIS.

1.6.1 Projects Addressed by the Cumulative Impact Analysis

Section 1.7.1 in Chapter 1 of the WCWEP and DRP EIS summarizes past and reasonably foreseeable projects that could cause impacts within the PRRP impact area of influence. The major potential impacts of these projects are summarized in Section 1.7.1 along with the primary resource topics that are associated with the interrelated projects. The WCWEP and DRP EIS uses the Proposed Action (Riverine Habitat Restoration) as an interrelated project for the purpose of evaluating potential cumulative impacts. Similarly, the Proposed Action (WCWEP With Daniel Replacement Pipeline) is considered an interrelated project for the purpose of evaluating cumulative impacts in the PRRP EIS. The primary resource topics related to the PRRP cumulative impact evaluations are aquatic resources, wetlands, wildlife resources, threatened and endangered species, recreation, agriculture and socioeconomics.

1.6.2 Projects Not Addressed by the Cumulative Impact Analysis

Projects not addressed by the PRRP cumulative impact analysis are the same as those identified and described in Section 1.7.2 in Chapter 1 of the WCWEP and DRP EIS.

1.7 Proposed Action (Riverine Habitat Restoration) — Physical Features and Other Characteristics

The Proposed Action (Riverine Habitat Restoration) would use a variety of measures to develop a more naturally functioning river system contiguous with its floodplain. These measures include river reconstruction, realignment, channel modifications, development of off-channel streams

Table 1-2
PRRP Authorizing Actions

Page 1 of 2

Agencies	Authorizing Action	Description and Project Feature
FEDERAL AGENCIES		
Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission)	Record of Decision for PRRP EIS	The Mitigation Commission needs to approve a Preferred Alternative and accept other commitments in the Record of Decision
U.S. Fish and Wildlife Service (FWS)	Review of EIS and Biological Assessment and issuance of a Biological Opinion to ensure Endangered Species Act is complied with and preparation of a Fish and Wildlife Coordination Act Report	FWS review and consultation is required to protect candidate, threatened and endangered species; FWS conducts formal Section 7 consultation on all listed species affected by the project and will issue a Biological Opinion after it reviews the project's Biological Assessment; it also will prepare a Fish and Wildlife Coordination Act report on the Proposed Action
U.S. Army Corps of Engineers (COE)	Issues Section 404 permits	Because construction of the project will cause placement of fill material and excavation in "waters of the U.S.," including wetlands, a Section 404 permit under the Clean Water Act would be needed from the COE
Environmental Protection Agency (EPA)	Has veto authority on Section 404 permits issued by COE; and 401 permits issued by water quality agency (see below); also reviews and rates all EISs	If the EPA feels potential wetlands, water quality or other impacts have not been sufficiently avoided or mitigated, it can suggest additional mitigation or new alternatives
U.S. Bureau of Reclamation (USBR), Mitigation Commission	Issues land-use license; responsibility for USBR flood control dikes along river	A land-use license would be required for new channel and dike construction on lands owned by USBR or on which USBR holds a construction easement; Provo River Water Users Association (PRWUA) has a contract with USBR to maintain dikes along the Provo River; the contract would be renegotiated to cover new dikes
Utah Department of Natural Resources (UDNR), Division of Water Rights, State Engineer	Approval of changes in water rights, diversions and places of water use; issues permits for modifying stream channels	Approval of the project's relocated diversions would be required; modifications to stream channels must be permitted under Utah State law (73-3-29, Utah Code Annotated)

Table 1-2
PRRP Authorizing Actions

Page 2 of 2

Agencies	Authorizing Action	Description and Project Feature
STATE AGENCIES		
UDNR, Utah Division of Parks and Recreation	Approve development within the authorized floodplain, through Utah River Enhancement statues	Approval would be required of development within the 100-year floodplain or within 150 feet of the river banks; a new floodplain would be adopted under the Proposed Action
UDNR, Utah Division of Wildlife Resources	Concur with the FWS Fish and Wildlife Coordination Act report	
Utah Department of Environmental Quality (UDEQ), Division of Water Quality	Issues Section 401 water quality certifications	A Section 401 water quality certification under the Clean Water Act would be issued once this agency determined the project's water quality impacts were sufficiently mitigated; required for Section 404 permits
Utah Department of Transportation (UDOT)	Issues approval to work in highway right-of-ways	Approval would be required to work in the right-of-way of State Highway 40
COUNTY AGENCIES		
Wasatch County Transportation Department	Issues permits for work in county road right-of-ways	Approval would be required to conduct channel construction activities in the right-of-ways for county roads crossing the channel alignment
Wasatch County Commissioners	Approve zoning changes	Zoning changes would be required to regulate future building in designated floodplain areas under the Proposed Action
HEBER VALLEY IRRIGATION COMPANIES		
Heber Valley Irrigation Companies	Agreements as needed	Agreements between local irrigation companies and the Mitigation Commission may be needed to specify the procedures used to modify diversions and canals

and ponds, revegetation and other approaches. All levees would be removed as long as adequate 100-year flood protection is provided by the expanded floodplain or a setback levee. A meandering riffle-pool channel interacting with a functioning floodplain would be developed wherever possible. In some areas, this could be accomplished by incorporating the present channel. In others, the present channel would be abandoned and a new channel alignment developed. Where possible, the river channel would be allowed to adjust its alignment within the designed meander width in response to changing hydrologic or geomorphic factors.

Table 1-3 lists the improvements that would be made in each reach of the Provo River under the Proposed Action. Map A-5 in the map pocket at the back of the EIS shows the location of the river channel alignment under the Proposed Action.

1.7.1 Channel Features

1.7.1.1 Features Common to All Reaches

The proposed channel would be a meandering riffle-pool channel characteristic of natural channels in low to moderately sloped valleys. Riffles would be constructed to create narrower, shallower and faster water portions of the channel. Pools would be constructed to create wider, deeper and slower water portions of the channel. Typical bankfull channel top–widths would vary between 80 to 100 feet in the pools and 70 to 80 feet in the riffles. The floodplain width would be 500 feet or greater in all areas where practical. Table 1-4 summarizes channel and floodplain characteristics under the Proposed Action on a reach-by-reach basis.

Existing river dikes would be breached or removed except where they provide protection to existing structures or other man-made features (e.g., ponds) to develop the necessary floodplain width. Figure 1-2 shows typical removal of a river dike. Small portions of existing dike that support significant communities of valuable riparian vegetation would be retained, as long as adjacent breached or removed sections would be large enough to allow channel overflows to spread out onto the floodplain.

The average flow velocities for the Proposed Action are presented in Table 1-4. With the diversity of instream features, velocities at specific locations would vary greatly from these values dependent on the exact horizontal and vertical location in the cross-section, and the position relative to features such as boulders, stream bank vegetation and organic debris. There also would be areas of much lower localized velocities within the stream than represented by the average velocities of Table 1-4.

Riffles would be constructed to maintain fish habitat throughout a range of river flows including low flows. A center low flow section ranging in width from 30 to 40 feet would be created by placement of an inner bench tied into the banks. This feature would maintain a minimum hydraulic depth of one foot during 125 cfs base flow conditions. Boulders would be situated intermittently along the slopes of the inner berms to help ensure riffle stability, to provide diversity in the velocity profile and to provide local protection from high velocity flows, which would improve fish passage during bankfull river flows. Boulders would be an integral part of the channel bed, anchored in place with footer rocks, to remain stable even in the highest flow events.

Two design features would be incorporated into the Proposed Action to ensure that the riffle profile remains stable. First, the material comprising the channel bed in the riffles would be larger than in the pools. The median size of riffle material would range between 8 and 12 inches. This would require selective handling and possibly mechanical sorting of source materials to achieve proper gradation. Second, minor grade control structures would be provided at both the upstream and downstream ends of each riffle. These structures would consist of vortex rock weirs or minor drops constructed of large boulders. Vortex rock weirs are integrated rock placements which are convex facing upstream and depressed in the center of the channel. They are designed to hold grade and direct flow energy toward the center of the channel away from the banks (see the PRRP Technical Report (CUWCD 1994a) Description of Proposed Alternatives for more detail on these structures). In some of the steeper riffles, a rapid could be created by a combination of boulders constricting and redirecting the flow in the horizontal plane and partial pour-overs or ledges redirecting the flow in the vertical plane.

Channel cross-sections in pools would be designed with the deepest portion against the outside bend and a point bar on the inside of the bend. The deep

Table 1-3
Summary of Proposed Action (Riverine Habitat Restoration) Improvements
Page 1 of 4

PRRP Study Reach	Improvements
Reach 1 Deer Creek Reservoir to End of Levees	• No improvements
Reach 2 End of Levees to Casperville	• Fill 3,250 feet of abandoned channel • Construct 6,500 feet of new channel • Remove or breach 5,410 ft of existing dike • Construct 1,800 feet of 2-ft high setback dikes to protect existing structures • Raise or lower floodplain elevation over an area of 3 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 7 acres of disturbed area • Extend Lower Charleston Canal 750 feet in upstream direction • Reconstruct Lower Charleston Diversion 750 feet upstream • Protect Winterton Bridge, gas line, and railroad crossing • Relocate Casper Bridge as directed by landowner • Construct one pond (1.1 acres) • Create 8,970 feet of side channels
Reach 3 Casperville to Island Ditch Diversion	• Fill 2,780 feet of abandoned channel • Construct 8,530 feet of new channel • Install 500 feet of special bank stabilization • Remove or breach 3,510 ft of existing dike • Construct 1,220 feet of 2-ft high setback dikes to protect existing structures • Raise or lower floodplain elevation over an area of 1 acre to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 6.5 acres of disturbed area • Relocate Everett Slough Diversion 250 feet to the southwest • Extend Everett Slough 800 feet to meet new headgate • Extend Spring Creek 160 feet west to meet new channel alignment • Protect Midway Road bridge and gas pipeline crossing • Reconstruct Island Ditch Diversion at existing location • Create 6,030 feet of side channels

Table 1-3
Summary of Proposed Action (Riverine Habitat Restoration) Improvements

Page 2 of 4

PRRP Study Reach	Improvements
Reach 4 Island Ditch Diversion to End of Levees	• Fill 5,040 feet of abandoned channel • Construct 7,900 feet of new channel • Raise or lower floodplain elevation over an area of 5.6 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 13.2 acres of disturbed area • Construct one pond (0.9 acres) • Create 5,070 feet of side channels
Reach 5 End of Levees to Probst Diversion	• Fill 3,320 feet of abandoned channel • Construct 5,770 feet of new channel • Install 200 feet of special bank stabilization • Remove or breach 6,280 ft of existing dike • Construct 1,300 feet of 2-ft high setback dikes to protect existing structures • Raise or lower floodplain elevation over an area of 7.3 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 13.9 acres of disturbed area • Reconstruct Probst Diversion 100 feet to southwest • Relocate 1,250 feet of Probst Irrigation Ditch • Cosntruct one pond (0.8 acres) • Create 5,460 feet of side channels
Reach 6 Probst Diversion to River Road	• Fill 6,050 feet of abandoned channel • Construct 10,770 feet of new channel • Install 1,500 feet of special bank stabilization • Remove or breach 11,600 ft of existing dike • Construct 2400 feet of 2-ft high setback dikes to protect existing structures • Construct 3570 feet of 3-ft high setback dikes to protect existing structures • Raise or lower floodplain elevation over an area of 4.1 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 13.1 acres of disturbed area • Extend Gertsch Ditch 1,500 feet upstream • Relocate Gertsch Diversion 1,500 feet upstream • Extend Wilson Ditch 350 feet upstream • Relocate Wilson Diversion 350 feet to northeast

Table 1-3
Summary of Proposed Action (Riverine Habitat Restoration) Improvements
Page 3 of 4

PRRP Study Reach	Improvements
Reach 6 (continued)	• Protect River Road bridge crossing • Construct three ponds (3.5 acres) • Create 16,700 feet of side channels
Reach 7 River Road to Baum Diversion	• Fill 2,460 feet of abandoned channel • Construct 4,980 feet of new channel • Remove or breach 2,890 ft of existing dike • Construct 2,480 feet of 2-ft high setback dikes to protect existing structures • Raise or lower floodplain elevation over an area of 4.1 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 6.9 acres of disturbed area • Create 4,040 feet of side channels • Relocate Baum Diversion
Reach 8 Baum Diversion to Valeo Diversion	• Fill 3,680 feet of abandoned channel • Construct 6,260 feet of new channel • Remove or breach 770 ft of existing dike • Remove 1,800 feet of existing Jordanelle wetland dikes • Construct 1,800 feet of new Jordanelle wetland dikes • Raise or lower floodplain elevation over an area of 13.8 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 19.8 acres of disturbed area • Create 5,230 feet of side channels • Construct three ponds (3.6 acres) • Reconstruct Wasatch Diverson 50 feet downstream of present location in Wasatch Canal • Relocate (place beneath proposed channel thalweg) 200 feet of Jordanelle wetland water supply line
Reach 9 Valeo Diversion to Old U.S. 40	• Fill 4,870 feet of abandoned channel • Construct 10,430 feet of new channel • Remove or breach 5,480 ft of existing dikes • Remove 2,300 feet of existing Jordanelle wetland dikes • Construct 1,500 feet of new Jordanelle wetland dikes

Table 1-3
Summary of Proposed Action (Riverine Habitat Restoration) Improvements

Page 4 of 4

PRRP Study Reach	Improvements
Reach 9 (continued)	• Raise or lower floodplain elevation over an area of 8.5 acres to provide for improved interaction between channel and floodplain or to prevent channel avulsion • Revegetate 15.6 acres of disturbed area • Create 3,860 feet of side channels • Relocate (place beneath proposed channel thalweg) 200 feet of Jordanelle wetland water supply lines • Construct 2 buried grade control structures (350 feet) • Reconstruct Condie Diversion 200 feet to northeast • Protect quarry bridge, gas pipeline, and Old U.S. 40 bridge crossings • Relocate private bridge crossing

Notes:

1. Special bank stabilization would be large rock buried in the channel bank at bends or other locations with high erosion potential.
2. Diversion structure reconstruction would be due to channel elevation and geometry changes; diversions must pass 125 cfs in the main channel.
3. Bridges and other crossings would be protected by placing large rock around abutments to prevent scour.

Table 1-4
Proposed Action (Riverine Habitat Restoration) Channel and Floodplain Reach Characteristics

									Mean Channel Velocity (ft/sec)					
Reach	Channel Length (ft)	Bankfull width (ft)		Floodplain width (ft)	Channel Slope (ft/ft)		Bankfull Depth (ft)		Base Flow		Bankfull Discharge		100-Year Discharge	
		Riffle	Pool		Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool
2	6,500	80	100	960	0.008	0.004	4.3	5.8	2.7	1.6	5.0	3.9	6.5	4.8
3	8,390	80	100	560	0.008	0.004	4.3	5.8	2.7	1.6	5.0	3.9	6.5	4.8
4	7,900	70	80	980	0.010	0.005	4.1	5.7	2.5	1.9	6.1	4.4	7.1	5.7
5	5,770	70	80	490	0.012	0.006	3.9	5.6	2.9	2.1	6.3	4.8	7.3	5.9
6	10,770	70	80	490	0.012	0.006	3.9	5.6	2.9	2.1	6.3	4.8	7.3	5.9
7	5,440	70	80	630	0.012	0.006	3.9	5.6	2.9	2.1	6.3	4.8	7.3	5.9
8	6,220	70	80	420	0.012	0.006	3.9	5.6	2.9	2.1	6.3	4.8	7.3	5.9
9	10,430	70	85	420	0.012	0.005	3.9	5.6	2.9	2.0	6.3	4.6	7.3	5.7

Notes:

Baseflow = 125 cfs
Bankfull Discharges = 1,200 cfs
100-year Discharge = 2,860 cfs

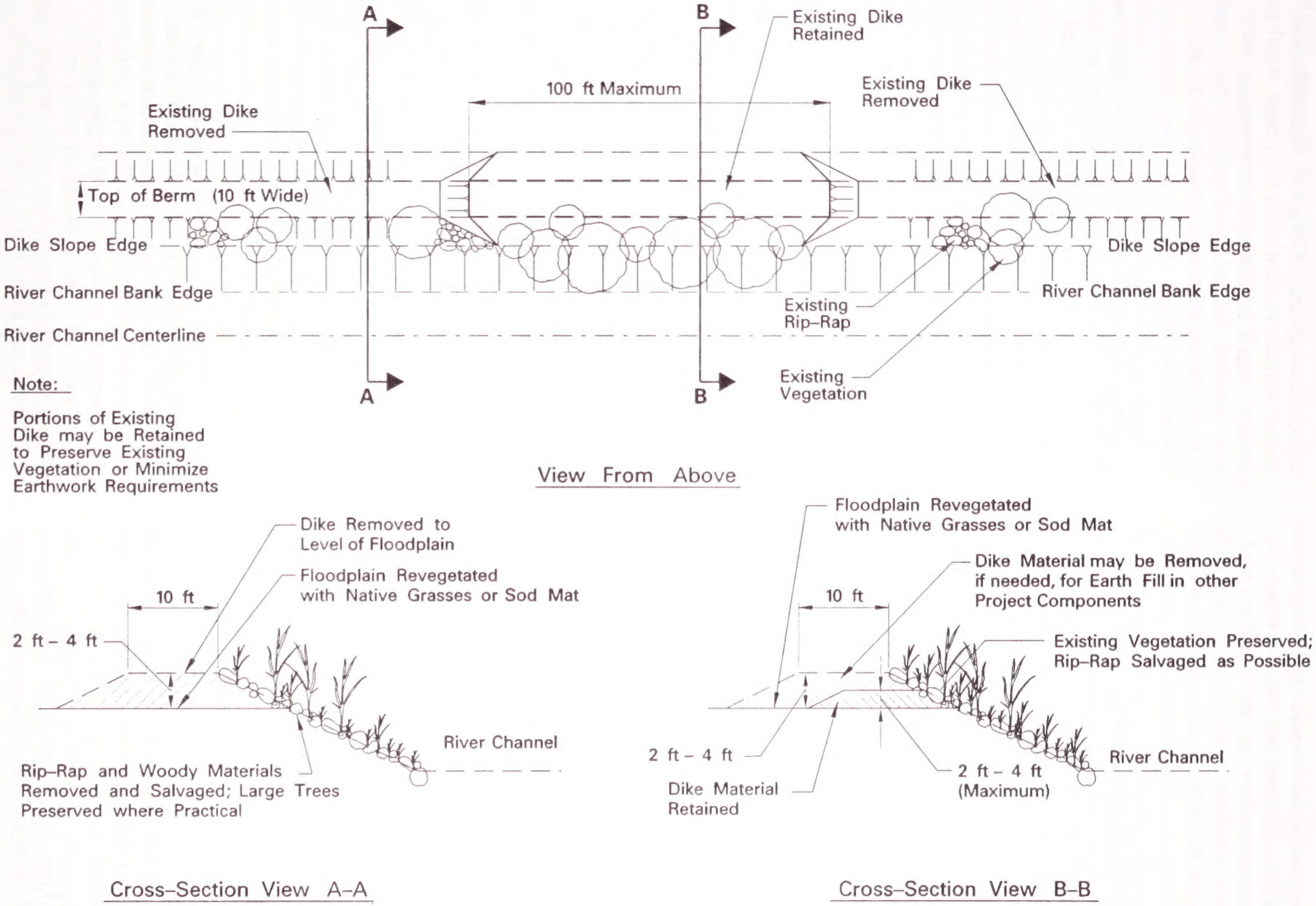

A
B
Existing Dike Retained
100 ft Maximum
Existing Dike Removed
Existing Dike Removed
Top of Berm (10 ft Wide)
Dike Slope Edge
Dike Slope Edge
River Channel Bank Edge
River Channel Bank Edge
Existing Rip–Rap
River Channel Centerline
Existing Vegetation
A
B
Note:
Portions of Existing Dike may be Retained to Preserve Existing Vegetation or Minimize Earthwork Requirements
View From Above
Dike Removed to Level of Floodplain
Floodplain Revegetated with Native Grasses or Sod Mat
10 ft
2 ft – 4 ft
River Channel
Rip–Rap and Woody Materials Removed and Salvaged; Large Trees Preserved where Practical
Cross–Section View A–A
Floodplain Revegetated with Native Grasses or Sod Mat
Dike Material may be Removed, if needed, for Earth Fill in other Project Components
10 ft
Existing Vegetation Preserved; Rip–Rap Salvaged as Possible
2 ft – 4 ft
River Channel
2 ft – 4 ft (Maximum)
Dike Material Retained
Cross–Section View B–B

Figure 1–2
Typical Removal of Existing Dike

portion of the pool at the outside of the bend is the natural condition. This feature would maintain contact between river flow and the vegetated bank during low flow conditions. Maximum depths in the pools at bankfull discharge would range from 5 to 6 feet.

The outside of the bends would be protected with large boulders, root wads and vegetation. The bank protection, where stresses are not too great and critical structures are not located adjacent to the channel, would be intermittent and have a somewhat irregular bank line. The large boulders would be used to deflect river flows away from the bank. Root wads would be used to protect the river bank from high velocity water, maintain bank stability and create scour holes. In areas that are deemed critical, the bank protection would be placed as a well-graded continuous rock feature. However, the continuous rock mass would be hidden by placement of boulders, woody debris, gravel and cobble, soils and vegetation. The rock blanket would act as a second line of protection in the event significant bank erosion starts in the critical areas.

In addition to constructed bank protection, the existing bank protection (i.e., riprap) would be left in place at locations where it protects existing buildings and other important features (e.g., utility crossings and bridge abutments) in the river corridor.

Buried grade control structures would be incorporated at two locations where control of potential channel degradation is important. The following describes these locations:

- In the first meander downstream of Old US 40, where the sediment-free reservoir discharges would have a strong tendency to erode the channel bed and banks

- Downstream of the new US 40 bridge, where the flow leaves a narrowly confined and high velocity section

Buried grade control structures would be constructed from placed rock and would not protrude above the channel bed.

In sections of the river where channel alignment is not restricted by diversions, bridges or other constraints, the channel may be allowed to make minor adjustments to the designed alignment over time in response to hydrologic and sediment transport conditions. Design of floodplain and terrace elevations, combined with bank stabilization features, would restrict adjustments to the area approximately defined by the meander belt width (i.e., the region between outside bends of the channel meanders).

Existing irrigation diversions would be reconstructed and some would be relocated under the Proposed Action. This is necessary because of proposed changes in the river alignment and bottom elevation and to eliminate the existing hard diversion dam sills and large drop features. The following diversion facilities would be relocated and the existing irrigation ditches would be extended to a new point of diversion:

- Lower Charleston Diversion
- Everett Slough Diversion
- Gertsch Diversion
- Wilson Diversion

Map A-5 in the pocket at the back of the EIS shows locations of existing and new points of diversion.

The Baum Diversion water right would be delivered to the existing point of diversion in a proposed side channel system because the main river channel would be relocated about 1,000 feet to the west. The need for the Valeo Diversion would be eliminated by designing the river to deliver adequate flow to the Wasatch Canal diversion point. Reconstructed diversions would be located on the outside bend of a river meander to improve operations under low flow conditions. Diversion structures would consist of headwalls and manually operated gates (similar to the existing structures) but there would be no hard sills spanning the entire river bottom. Boulder placements, as well as the natural channel structure on the outside of a meander, would direct flows to the diversion structure even during low water periods.

Most of the existing road and pipeline crossings could be preserved under the Proposed Action. Exceptions are the Casper Bridge and the private bridge in the upper portion of Reach 9, which would be relocated to accommodate the new channel alignment. All other crossings by major roads, railroads, and utility pipelines would remain intact. Abutments and piers would be protected with placement of large rock salvaged from the existing levee riprap.

1.7.1.2 Specific Reach Features

Improvements are not proposed for Reach 1 because it falls within the Deer Creek Reservoir flood easement and is subject to inundation during periods of maximum reservoir storage. This creates a situation in which improvements would be short-lived because of sediment deposition and highly variable hydraulic conditions.

Short sections of Reaches 3, 7 and 8 would have step-pool or riffle-pool channel geomorphology. This channel type is defined as moderately entrenched, with a moderate gradient and relatively straight planform, and dominated by riffles and small drops with infrequently spaced pools. The channel segments designed with these characteristics are required because of a combination of manmade and natural constraints that force the channel into a straight alignment for distances of about 1,000 feet.

A meandering riffle-pool section is proposed for Reach 4 to ensure compatibility with upstream and downstream reaches. The existing Reach 4 system has multiple shifting channels, and a broad floodplain unrestrained by dikes. Past channel instability in this section has been created by deposition of sediment carried through upstream diked reaches. Proposed upstream river modifications as well as the regulated Jordanelle Reservoir releases should reduce the sediment deposition problems in this reach. The new river alignment would be "defined" in a manner similar to the upstream and downstream sections to ensure long-term geomorphic stability of the proposed channel. This would require the construction of a narrower, and in some cases 1 to 2 feet deeper, channel than the existing main channel. Channel design in this reach would utilize the existing active channel features as much as possible. The current channel is expected to continue shifting in the near future as it adjusts to changed upstream conditions. Major changes in the proposed alignment and profile may be necessary during final design to maximize utilization of active channel features present at that time.

1.7.2 Floodplain Features

A key component of the meandering riffle-pool channel design is sizing the cross-section so flows spill into the floodplain on nearly an annual basis. This would benefit channel stability and the surrounding riparian corridor. The floodplain interaction would be accomplished by selecting channel dimensions to convey approximately 1,200 cfs (1.5-year peak flow). River flows would spill into the floodplain when 1,200 cfs river flow is exceeded. The surrounding area would be selectively contoured to create a floodplain where necessary. Every effort would be made during final design to minimize the amount of off-channel grading required to establish contact between the channel and the floodplain. Grading would disturb the vegetation and topsoil in the riparian corridor and would be avoided where practical. Graded areas would be returned to existing vegetation and land uses in areas outside the public access corridor. Vegetation consistent with natural upland areas would be established in areas that the federal government would acquire for the project.

The old channel would be incorporated as the floodplain for the restored channel in some areas. This would be accomplished by only partially backfilling the old channel where it lies on the inside of new channel bends. The restored channel would be aligned away from historical terraces and river bed slopes would be varied in the riffle and pool sequence to minimize the need for grading. The transition between the channel and the floodplain on the inside of the bends would be subtle. The point bars would be sloped up to the floodplain at an average slope of 5 to 7 percent. This would encourage initial channel overflows to occur on the inside of river bends and promote more extensive riparian vegetation development on the point bars and within the meander belt-width corridor.

The meandering channel with connected floodplain in the Proposed Action offers opportunities for incorporation of several desirable floodplain features, including ponds, side channels and setback dikes.

1.7.2.1 Ponds

The Proposed Action includes eight new ponds located throughout the impact area of influence. The ponds would provide a combination of emergent marsh and open water habitat that would add considerable diversity and unique habitat features to the project. Aside from the constructed Jordanelle Wetland cells, the only significant floodplain ponds in the river corridor are Condie, Berkenshaw and Hogle.

Ponds would be excavated to accommodate a water depth ranging from 10 to 15 feet. This depth would be required to minimize the growth of aquatic weeds and limit the freezing depth to maintain adequate year-round fish habitat. In most cases water would be supplied to the ponds from the Provo River through open channels. A secured water right for these features would probably be required. An inlet and outlet would be constructed at each pond to provide flow-through of the water. In some cases water may be available from natural springs or groundwater. Ponds would be sealed by one or more methods to reduce water loss through infiltration. Lining alternatives include compaction of granular soils and application and tilling of bentonite. In the event some ponds are excavated to a depth that intercepts the groundwater table, no liner would be required. Spoil from pond construction would be disposed of in the same manner as spoil from construction of the main channel (see Section 1.7.3.1).

The minimum pond size would be 3/4 acre, including the open water and emergent marsh areas, to make it a reasonably viable habitat resource. Ponds one acre and larger could accommodate one or more small islands to provide nesting habitat for waterfowl with protection from land predators. Islands would be planted with riparian vegetation such as cottonwood, willow and riparian grasses.

The perimeters of the ponds would be constructed with an irregular edge to maximize habitat value and blend more naturally with adjacent upland and riparian vegetation. Ponds would provide habitat for aquatic and terrestrial wildlife. Adjacent areas surrounding the ponds and emergent marsh could be developed to support riparian vegetation such as cottonwood and willows to provide more ecological diversity along the river corridor.

Ponds would be constructed to provide a 6- to 20-foot-wide shelf area around the pond perimeter where the topography is graded to elevations ranging from four inches to two feet below the water surface. This shelf area would be planted with emergent plant species such as bulrush and pondweed. The emergent marsh habitat would provide food and cover for wildlife and waterfowl.

Public access and a construction easement would be acquired at each pond site, extending approximately 50 feet outward from the pond perimeter. Most proposed pond sites are within the access and construction corridor, which would be needed for the restored channel alignment. Where ponds are outside the main corridor, the public access area would be fenced to exclude cattle and protect the resource.

The location of pond sites is shown on Map A-5 in the map pocket at the back of the EIS. Exact numbers, locations and "footprints" would be adjusted during final design based on local topography, soil conditions, vegetation, landowner preferences and other factors. Table 1-5 summarizes the pond acreage to be constructed in each reach of the project. Approximately 5.6 acres of open water ponds would be constructed along the Provo River corridor.

1.7.2.2 Side Channels

The Proposed Action would include 14 side channels in Reaches 2 through 9. The main purpose of side channels would be to provide additional fish habitat and aquatic diversity. In addition, they would enhance wetland areas off the main river channel. The side channels would carry fairly constant flows up to about 10 cfs. These flow levels would be adequate to simulate small spring-fed stream conditions without reducing flows and associated habitat in the main channel.

Two types of side channels are proposed. The first type would involve construction of new small meadow-type channels in the floodplain. These channels would be best suited to areas with 3 to 5 inches of topsoil and vegetation forming a sod mat. The typical constructed side channel cross-section would have a depth of about 2 feet and a width of 2 to 3 feet. The alignment would be highly sinuous. Water velocities typically would be 1 to 2 feet per second to prevent scour of vegetation and soil.

The second type of side channel would use remnants of abandoned distributary channels or abandoned irrigation ditches in the floodplain. These remnants are typically mildly meandering sections, and some are currently incorporated into the existing irrigation conveyance system. Several of the existing remnant channels are surrounded by cottonwood galleries which would create riparian canopy cover conditions for the side channels. The effort required to develop these side channels would be relatively small, provided the remnant channels have the appropriate cross-section relative to the

Table 1-5
Ponds and Side Channels Developed Under the Proposed Action (Riverine Habitat Restoration)

	Pond Area		Side Channel	
Reach	Open Water (acre)	Total Length (ft)	Length Outside Abandoned Channel (ft)	Total Area* (acre)
2	0.6	8,970	900	2.6
3	0	6,030	1,510	1.7
4	0.5	5,070	2,540	1.5
5	0.3	5,460	280	1.6
6	2.2	16,740	11,690	4.8
7	0	4,040	4,040	1.2
8	2.0	5,230	0	1.5
9	0	3,860	3,470	1.1
Total	**5.6**	**55,400**	**24,430**	**16.0**

Note:

*Side channel area = the channel length x 12.5 feet width which includes a 2.5 foot wide channel

available flow. In some cases, minor modifications of the existing features would be made to balance conveyance capacity with the available flows.

Side channel flows would be diverted from the main river channel using passive diversion systems (i.e., no manually operated headgates). These could consist of small pipes through the channel bank to the side channel or buried infiltration trenches (french drains) composed of boulders and large cobble. Experimentation would be necessary to select designs that minimize long-term maintenance requirements. All side channels would discharge back to the main river channel, allowing fish migration from the main river into the side channels.

Net water losses in the off-channel side channels and ponds would occur from consumptive losses such as evapotranspiration and, in some instances, percolation to the shallow groundwater aquifer. Therefore, a designated water right would be required to support these features. It is estimated that a total water right of about 1 cfs would be required to compensate for consumptive uses of side channels and ponds under the Proposed Action.

This water allocation could be provided by the water rights associated with the lands to be acquired under the Proposed Action. Approximately 60 irrigated acres could be acquired under baseline conditions, and an additional 149 acres could be acquired under the Proposed Action. The Morse Decree allocated up to 1 cfs per 60 irrigated acres in Heber Valley outside of the North Fields area during the growing season. At this rate, a water right of up to about 3.5 cfs could be acquired by the federal government as part of the public access requirements. In normal hydrologic years this full water right can be supplied at the beginning of the season, but available water falls to about half the right by the end of the growing season. This would be sufficient to support the proposed off-channel features (side channels and ponds).

Development of side channels would require acquisition of public access and a construction easement to and along these features. The area would be fenced to protect the resource. It is assumed that a typical public access and construction buffer of 50 feet on each side of the side channel would be acquired. The majority of proposed side channels would be located within the main public access corridor and would not require separate access zones.

Map A-5 in the map pocket at the back of the EIS shows the approximate locations of side channels. These features would be refined during final design based on local topography, soils, vegetation, landowner preferences and other factors. Table 1-5 in Section 1.7.2.2 lists side channel lengths by stream reach. It shows the total side channel length, as well as the new constructed side channel length (i.e., excluding side channels created using existing channels and ditches) that is outside the abandoned channel area.

1.7.2.3 Setback Dikes

Setback dikes would be required in some areas to limit the 100-year floodplain to non-hazardous areas after removal of the existing dikes. Setback dikes would have a typical height of 2 to 4 feet and a top width of 15 to 30 feet. Figure 1-3 shows a schematic of a typical setback dike. They would be designed to blend in with existing fields and pastures to minimize visual impacts. Setback dikes would be located far enough from the channel to maintain geomorphically suitable floodplain conditions.

A revegetation and monitoring/maintenance plan would be developed for the setback dikes as part of final design. Most setback dikes would be located in active agricultural and grazing parcels; these would be revegetated to pre-construction conditions to the extent possible. Revegetation methods are discussed further in Section 1.11.7.1.

Locations of proposed setback dikes are shown on Map A-5 in the map pocket at the back of the EIS. Table 1-3 in Section 1.7 lists setback dike lengths by stream reach.

1.7.2.4 Abandoned Channel

Abandoned reaches of the existing channel that are not in locations of proposed ponds or side channels would be filled to the new floodplain level. Figure 1-4 shows how the abandoned channel cross-section would be filled. These filled areas would be revegetated and integrated into the adjacent land. The source of fill material would be from excavation of the new channel. Because the project would have excess excavated material compared to fill requirements, placing material in the abandoned channel reduces off-site disposal haul requirements. The abandoned channel areas that would be filled are within the baseline public access corridor, and would remain in the public access corridor under the Proposed Action. Therefore none of these areas would be available for agricultural uses. Map A-5 (see pocket at back of EIS) shows abandoned channel areas that would be filled; other sections of abandoned channel would be set aside for pond and side channel creation. These channel areas have been conceptually identified at this time, and represent a “worst-case” condition for impact analysis. Specific decisions on treatment of particular sections of abandoned channel would be made during final design.

1.7.2.5 Jordanelle Wetlands

The Proposed Action would encroach into some of the U.S. Bureau of Reclamation (USBR) constructed Jordanelle Wetlands area to develop sufficient floodplain width in Reaches 8 and 9. This would require relocating some of the outside wetland dikes and removing imported wetland topsoil to lower the ground elevation to the new design floodplain level. A cross-section of the typical encroachment into the USBR wetlands is shown in Figure 1-5. Dikes would be reconstructed to confine the wetland ponds at the edge of the new floodplain; removed topsoil would be salvaged for use elsewhere in the project. Map A-5 in the map pocket at the back of the EIS shows locations of modifications to the Jordanelle Wetlands ponds and dikes.

1.7.2.6 Public Access

The seven public access points shown on Map 1-1 in Section 1.3.1 and an access corridor along the existing river channel would be developed under baseline conditions. Under the Proposed Action, the public access area would be expanded to include the new channel plus a 50-ft buffer on each side of the new channel, and all side channels and ponds with a similar 50-ft buffer on all sides. "Islands" of private property that could be created between access areas for the main channel and off-channel features are assumed to be acquired for the public access corridor. This same corridor would be used for construction access for all project features.

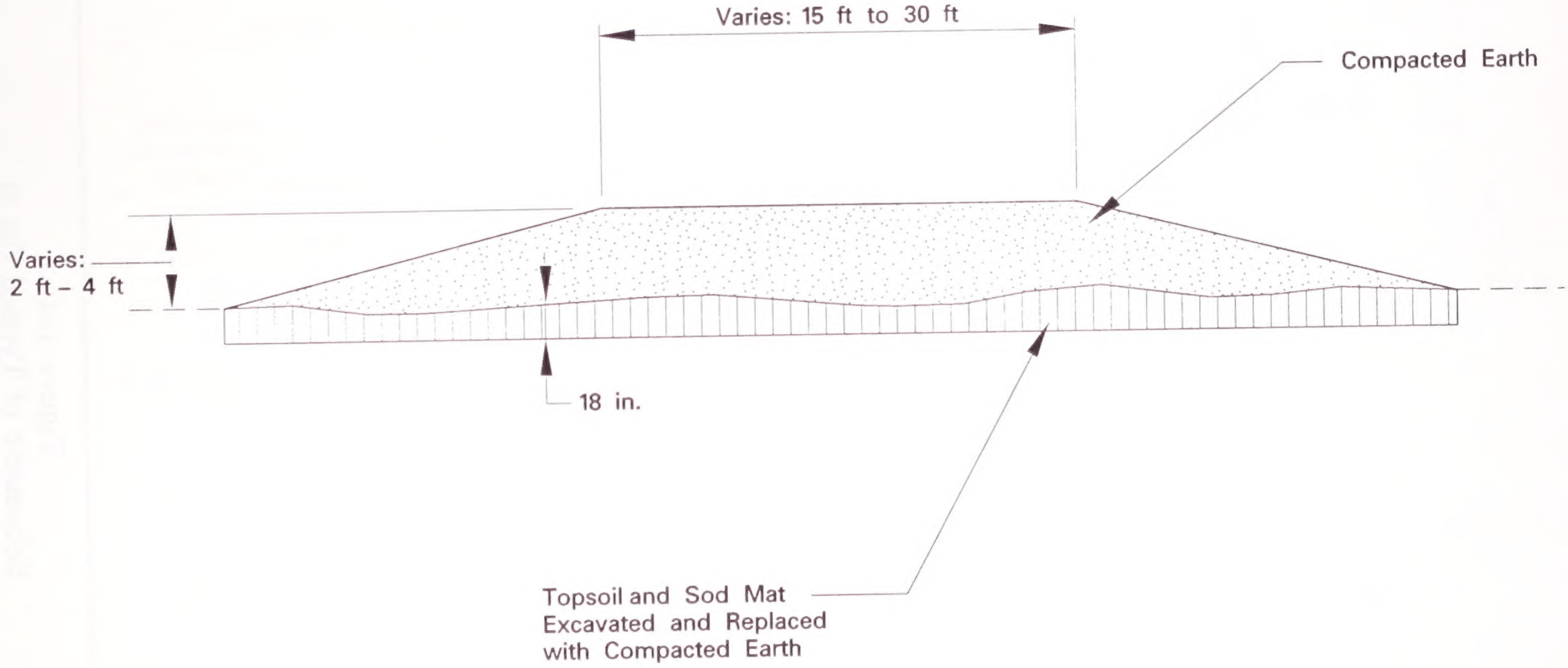


Figure 1–3
Schematic Cross–Section of
Typical Setback Dike

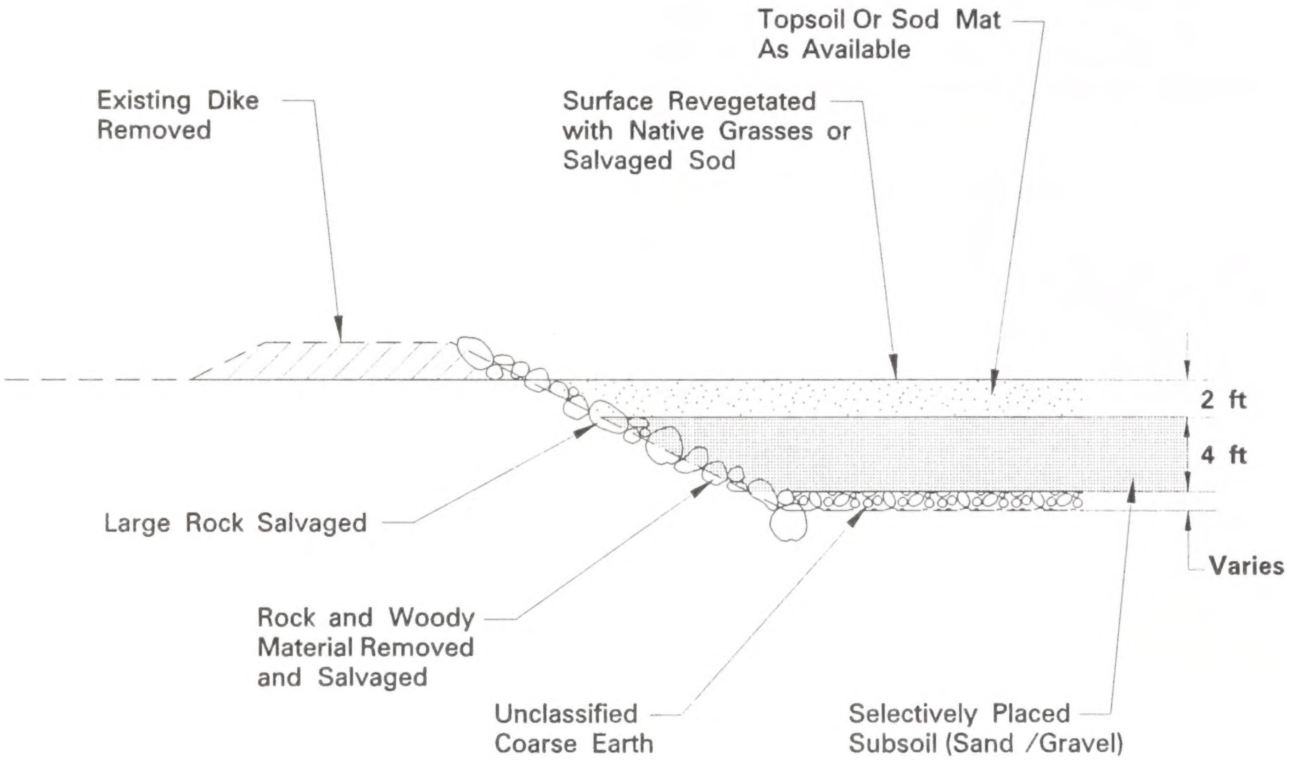

Topsoil Or Sod Mat As Available
Existing Dike Removed
Surface Revegetated with Native Grasses or Salvaged Sod
2 ft
4 ft
Varies
Large Rock Salvaged
Rock and Woody Material Removed and Salvaged
Unclassified Coarse Earth
Selectively Placed Subsoil (Sand /Gravel)

Figure 1–4
Schematic of Typical Fill of
Existing Channel to be Abandoned

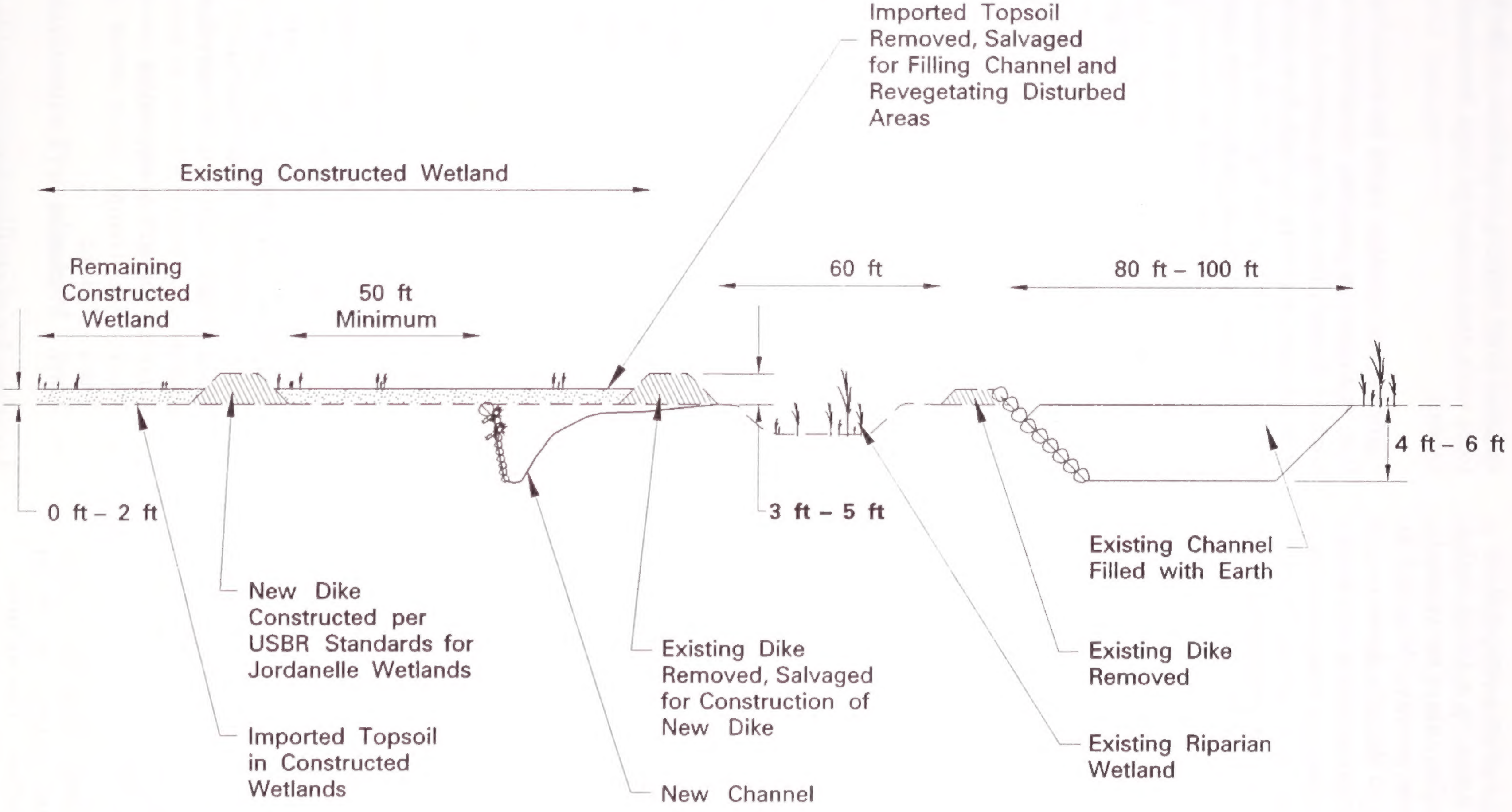

Imported Topsoil Removed, Salvaged for Filling Channel and Revegetating Disturbed Areas
Existing Constructed Wetland
Remaining Constructed Wetland
50 ft Minimum
60 ft
80 ft – 100 ft
0 ft – 2 ft
3 ft – 5 ft
4 ft – 6 ft
Existing Channel Filled with Earth
New Dike Constructed per USBR Standards for Jordanelle Wetlands
Existing Dike Removed, Salvaged for Construction of New Dike
Existing Dike Removed
Imported Topsoil in Constructed Wetlands
New Channel
Existing Riparian Wetland

Figure 1–5
Cross–Section of Typical Encroachment into
Bureau of Reclamation Constructed Wetlands

Where the new channel lies against a steep hillside (e.g., the lower portion of Reach 7), a 100-ft buffer would be acquired on the valley side of the channel to accommodate construction activity. Map A-7 in the map pocket at the back of the EIS shows assumed public access and construction access areas for this alternative. Assumed access areas could be changed in the future because of Proposed Action feature changes in the final design or resulting from negotiations with specific landowners.

Newly acquired public access areas along the river corridor would be fenced. This would keep livestock out of the river channel and other created water features, and keep the public inside the corridor to minimize impacts on adjacent landowners. Most existing federally owned parcels are already fenced; it is assumed that those that are not would be fenced as part of baseline conditions, along with the remainder of the baseline public access corridor.

Additional information on assumptions related to land ownership and property acquisition is presented in Section 1.11.1.

1.7.3 Construction Procedures

1.7.3.1 Typical Construction Procedures

The Proposed Action would be constructed from upstream to downstream, with work alternating between new and old sections of channel to keep the active work area relatively dry during construction. A cofferdam (a temporary small dam typically constructed of native material or plastic tubing or sheeting) would be constructed in the existing channel at each new meander to isolate the river flow from the new channel construction area. New river channel segments would be constructed one at a time. The new river channel segments would initially receive small amounts of water to wash sediments into temporary in-channel settling ponds prior to opening the channel up to continuous flow conditions. The sediments would be removed from the settling ponds and then the river flow would be routed through the new channel down to the next downstream cofferdam and new meander.

Salvageable materials excavated from the existing channel would be sorted and stockpiled on site for use in new channel construction. This includes boulders and large rocks from the existing levees; river cobble from the existing river bottom; woody material from existing vegetation on the banks (root wads, tree trunks and large branches); and topsoil.

Timing of construction would be scheduled such that, to the extent possible, construction of the new channel through the existing channel alignment would not occur during the high flow period in May through July. During the high flow period, off-channel project elements such as side channels, ponds and setback dikes could be constructed. Depending on hydrologic conditions and Jordanelle Reservoir levels, Jordanelle Reservoir releases could be reduced during construction to facilitate equipment ingress/egress and construction activity. No plan for this has been developed at this time, and any such plan would have to be approved by downstream irrigators and other water rights holders, as well as by environmental agencies.

Jordanelle Reservoir water releases would be managed for approximately 5 years following construction to prevent the occurrence of severe flood flows. This would allow vegetation to become well-established along the channel banks. Minor flooding would be allowed outside the channel to encourage the development of riparian vegetation in the floodplain. A specific reservoir management plan has not been formulated at this time, and would be dependent on reservoir storage conditions at the time of construction. The reservoir management plan would assure that all water rights and downstream water delivery obligations would be met during construction.

The following equipment could be used to construct the Proposed Action:

- Backhoe - Cat 426 or equivalent
- Compactor - Cat 816B or equivalent
- Dozer - Cat D7 or equivalent
- Excavator - Cat 235 or equivalent
- Excavator - Cat 245 or equivalent
- Loader - Cat 966C or equivalent
- Motor Grader - Cat 14G or equivalent
- Pickup
- Scraper - Cat 621 or equivalent
- Truck - Rear Dump
- Truck - Flatbed
- Truck - Mechanics

Locations for stockpiling materials onsite would be determined during design and construction, with close coordination among landowners, the proper agencies and the contractor, and would be selected to minimize impacts on existing land uses and environmental features.

Construction would not affect existing utilities. No utilities are buried in the construction zone, and suspended utilities crossing the river would be protected in place during and after construction.

1.7.3.2 Typical Noise Levels and Air Emissions

Table 1-8, Section 1.8.2.3 in the WCWEP and DRP EIS defines typical noise levels that would be associated with operation of the types of equipment required for construction of the Proposed Action.

Table 1-9, Section 1.8.2.3 in the WCWEP and DRP EIS defines typical air emissions associated with the types of construction equipment that would be used to construct the Proposed Action.

1.7.3.3 Temporary Construction Access

Construction workers and equipment would gain access to the river corridor at public road access points. An additional temporary access road would be constructed along the Heber Valley Railroad/State Parks ROW in Reach 2. Negotiations would be conducted with landowners west of the river in Reach 5 to determine whether temporary construction access could be obtained from some point along River Road.

A minimum 50-foot construction access zone would be established along both sides of the entire reconstructed channel/floodplain. Where this zone is within a federally-owned parcel or within a federal construction easement, no additional access approvals would be required. Except in the upper portion of Reach 4, existing federal easements provide authority for channel construction and worker and equipment access. Proposed construction access areas are shown on Map A-7 in the map pocket in the back of the EIS. Section 1.11.1 discusses issues related to acquiring construction access areas.

1.7.4 Maintenance Procedures

The Proposed Action would require long-term annual monitoring of channel stability and revegetation conditions. Routine annual inspections of the channel would be required to assure that lateral and vertical erosion forces were being controlled, and that any revegetation projects were successful. The Mitigation Commission would develop a management agreement with an appropriate entity to provide management, maintenance and security.

High stress zones on newly constructed channel banks would be inspected often during the first five years after construction to assure that erosion was being managed. Vegetation planted for bank stabilization would be carefully monitored for successful rooting and propagation. A program would be developed for controlling growth of noxious plants in revegetated areas. Noxious weed control is discussed in Section 1.11.7.1. Appendix A presents a noxious weed control plan that would be used to control weeds in the constructed areas.

The Proposed Action does not include any new structures that would have to be maintained, repaired or replaced on a regular basis after a mature riparian zone has been established. Maintenance of irrigation diversions and retained dikes would continue to be the responsibility of the irrigation companies or private irrigators. It would be necessary to examine and potentially modify the current maintenance and repayment contracts between Provo River Water Users Association and the United States to assure that they would be applicable to the new river channel.

1.8 Existing Channel Modification Alternative — Physical Features and Other Characteristics

The Existing Channel Modification Alternative would attempt to enhance river mechanics, fish habitat and other environmental features and values by making channel modifications within the existing Provo River channel or leveed area. In some cases these modifications would extend to the present construction and flood easement boundary.
Table 1-6 in this section and Map A-6 in the map pocket at the back of the EIS present the Existing Channel Modification Alternative improvements.

Table 1-6
Summary of Existing Channel Modification Alternative Improvements

Page 1 of 3

PRRP Study Reach	Improvements
Reach 1 Deer Creek Reservoir to End of Levees	• No improvements
Reach 2 End of Levees to Casperville	• Modify 5,500 feet of existing channel • Remove western dike along 3,640 feet of existing channel • Construct 4,000 feet of 2 ft high setback dikes • Install 140 feet of special bank stabilization • Revegetate 12.4 acres of disturbed area • Reconstruct Lower Charleston Diversion • Protect Winterton Bridge, gas line, railroad, and Casper Bridge crossings
Reach 3 Casperville to Island Ditch Diversion	• Modify 7,510 feet of existing channel • Install 120 feet of special bank stabilization • Remove western dike along 4,700 feet of existing channel • Construct 5,000 feet of 2 ft high setback dikes • Revegetate 26.1 acres of disturbed area • Reconstruct Everett Slough Diversion • Extend Everett Slough Ditch 520 feet upstream • Protect Midway Road bridge and gas pipeline crossing • Reconstruct Island Ditch Diversion
Reach 4 Island Ditch Diversion to End of Levees	• Modify 6,920 feet of existing channel • Install 980 feet of special bank stabilization • Revegetate 2.6 acres of disturbed area
Reach 5 End of Levees to Probst Diversion	• Modify 4,440 feet of existing channel • Revegetate 24.5 acres of disturbed area

Table 1-6
Summary of Existing Channel Modification Alternative Improvements

Page 2 of 3

PRRP Study Reach	Improvements
Reach 6 Probst Diversion to River Road	• Modify 8,720 feet of existing channel • Install 480 feet of special bank stabilization • Remove eastern dike along 1,330 feet of existing channel • Remove western dike along 2,930 feet of existing channel • Construct 2,800 feet of 2 foot-high setback dikes • Construct 1,400 feet of 3 foot-high setback dikes • Revegetate 22.1 acres of disturbed area • Reconstruct Probst Diversion 200 feet upstream • Extend Probst Diversion ditch 300 feet upstream • Reconstruct Gertsch Diversion • Reconstruct Wilson Diversion • Protect River Road Bridge
Reach 7 River Road to Baum Diversion	• Modify 4,730 feet of existing channel • Remove western dike along 1,300 feet of existing channel • Construct 1,300 feet of 2 foot-high setback dikes • Install 80 feet of special bank stabilization • Revegetate 14.1 acres of disturbed area • Reconstruct Midway Diversion • Extend ditch to Baum Diversion 370 feet upstream • Reconstruct Baum Diversion 250 feet upstream
Reach 8 Baum Diversion to Valeo Diversion	• Modify 4,600 feet of existing channel • Remove eastern dike along 1,550 feet of existing channel • Remove western dike along 740 feet of existing channel • Construct 80 feet of 2 foot-high setback dikes • Construct 250 feet of 3 foot-high setback dikes • Construct 110 feet of buried grade control structure • Construct 240 feet of special bank stabilization • Revegetate 19.6 acres of disturbed area • Reconstruct Wasatch Diverson

Table 1-6
Summary of Existing Channel Modification Alternative Improvements

Page 3 of 3

PRRP Study Reach	Improvements
Reach 9 Valeo Diversion to Old U.S. 40	• Modify 8,460 feet of existing channel • Remove eastern dike along 5,730 feet of existing channel • Construct 2,000 feet of 2 foot-high setback dikes • Construct 1,000 feet of 4 foot-high setback dikes • Construct 350 feet of buried grade control structure (2) • Revegetate 28.2 acres of disturbed area • Reconstruct Condie Diversion 130 feet to east • Protect quarry bridge, gas pipeline, private bridge, and Old U.S. 40 bridge crossings

Notes:

1. Channel modifications would consist of regrading the existing cross section (see Figure 1-1) and developing a rapid-pool or step-pool sequence.
2. Special bank stabilization would be large rock buried in the channel bank at bends or other locations with high erosion potential.
3. Diversion structure reconstruction would be necessary because of grade and geometry changes; diversions must pass 125 cfs in the main channel.
4. Bridges and other crossings would be protected by placing large rock around abutments to prevent scour.

1.8.1 Channel Features

1.8.1.1 Features Common to All Reaches

A step-pool or rapid-pool channel would be developed between the existing levees wherever this width is sufficient to accommodate the peak 100-year water discharge. Existing levees would be removed and setback levees would be constructed near the edge of the existing construction and flood easement or federal land boundary where the leveed area is not wide enough to support this design. Map A-6 in the map pocket at the back of the EIS shows locations where existing levees would be retained and where setback dikes would be constructed.

The constructed channel would be composed of a sequence of pools, rapids or riffles, and steps (nearly vertical drops of about 1 foot with a 1.5 ft deep pool at the base). Riffles and pools would have similar cross-section geometries in this alternative. Rapids and riffles under low-water conditions would provide a minimum hydraulic depth of one foot at the minimum flow of 125 cfs and maintain flow contact with the channel banks at seasonally higher flow. The compound riffle cross-section would not only provide increased flow depth during the minimum flow condition but would provide cross-sectional diversity to promote the growth and maintenance of a healthy aquatic habitat. Large rocks and boulders placed and anchored within the riffles would serve as local roughness elements to promote riffle stability and provide fish passage during the higher runoff and accompanying higher velocity flood events. The placement of boulders would be performed in patterns that direct the main current to the center of the cross-section and relieve stress on the banks.

The proposed pool section would provide adequate flow depth and quiet water at the base and top of each riffle zone. The lower velocities within the pool sections would result in a finer bed material than the riffles.

The channel geometry would provide interaction between the main channel and floodplain at recurrence intervals greater than the 1,200 cfs, 1.5-year flow event. Volume 2 of the PRRP Technical Report (CUWCD 1994a) presents schematics of the rapid and pool channel sections used in the Existing Channel Modification Alternative hydraulic design.

Table 1-7 summarizes channel and floodplain reach characteristics for the Existing Channel Modification Alternative. Typical channel widths at bankfull levels would vary from approximately 65 to 100 feet, incorporating both riffles and pools. Riffles would range from 65 to 80 feet in top-width. There would be a 15 to 25 percent increase in top-width of the adjacent pool section reflecting a range between 80 and 100 feet. Pool widths would be increased to accommodate the construction of point bars in mildly meandering sections and to allow for flow expansion and energy dissipation of the high velocity flows descending across the riffles.

Vortex rock weirs would be placed at the upstream and downstream ends of each riffle and rapid to retain river bed elevations and direct energy toward the center of the channel and away from the banks. Where larger grade changes are required, an additional 1-foot drop would be constructed downstream of a vortex rock weir with a minimum 1.5-ft plunge pool below the weir to assist in upstream fish migration.

The topography and valley slope generally act as the primary controls dictating channel grade along each reach. The location of bridges, points of irrigation diversion, and tributary confluences act as local controls on bottom elevations in the deepest part of the channel. These bottom elevations would be controlled at or near existing grade to minimize the relocation of diversions or off-site disturbance.

Protection of the bottom of streambank slopes and natural channel revetment would be an integral part of the channel design to control erosion of the bed and banks. Minimum sediment movement out of the pools is anticipated because of the lower water velocities in the pools. Upstream sediment production must be minimized to ensure the longevity of the individual pools. Although the geomorphic basis of the design minimizes bank shear stress throughout the majority of the impact area of influence, bank protection and stabilization of the riffles would be essential. Natural bank revetment, including selectively placed boulders, root wads and vegetation mats, would be incorporated along critical reaches.

Existing irrigation gates may have to be modified or reconstructed as necessary as part of baseline conditions in order to pass the minimum 125 cfs baseflow while diverting the designated water right

Table 1-7
Existing Channel Modification Alternative Channel and Floodplain Reach Characteristics

									Mean Channel Velocity (ft/sec)					
Reach	Channel Length (ft)	Bankfull Width (ft)		Floodplain Width (ft)	Channel Slope (ft/ft)		Bankfull Depth (ft)		Base Flow		Bankfull Discharge		100-Year Discharge	
		Riffle	Pool		Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool
2	5,500	80	100	160	0.010	0.003	3.7	6.0	2.2	1.1	5.5	3.8	7.0	5.6
3	7,510	80	100	160	0.010	0.003	3.7	6.0	2.2	1.1	5.5	3.8	7.0	5.6
4	6,920	65	80	720	0.015	0.005	3.6	6.1	2.6	1.6	6.9	4.6	7.7	6.8
5	4,440	65	80	220	0.015	0.005	3.6	5.9	2.8	2.0	7.5	5.1	9.4	7.0
6	8,720	65	80	180	0.015	0.005	3.6	5.9	2.8	2.0	7.5	5.1	9.4	7.0
7	4,730	65	80	160	0.015	0.005	3.6	5.9	2.8	2.0	7.5	5.1	9.4	7.0
8	4,600	65	80	180	0.015	0.005	3.6	5.9	2.8	2.0	7.5	5.1	9.4	7.0
9	8,460	80	100	130	0.020	0.005	2.9	5.7	2.6	1.4	7.2	4.3	9.4	6.1

Notes:

Base Flow = 125 cfs
Bankfull Discharge = 1,200 cfs
100-Year Discharge = 2,860 cfs

during low flow periods. Modification to these diversion facilities would have to be coordinated with the requirements of the Existing Channel Modification Alternative relative to necessary modifications to the channel grade and cross-section to avoid reconstructing the diversion facilities more than once. Existing concrete and log sills (diversion dams) would be replaced with vortex rock weirs to control the river bed elevation and water surface at the diversion points. The large drops below the existing diversion sills would be graded out as part of the channel reconstruction.

Crossings by roads, railroads, and utility pipelines would remain intact. Abutments and piers would be protected with placement of large rock salvaged from the existing levee riprap.

1.8.1.2 Specific Reach Features

Wider pools and riffles would be used in the downstream sections (Reaches 2 and 3), and narrower pools and riffles would be used in the upstream sections (Reaches 5-8). The width of pools and riffles is primarily a function of channel slope.

Reach 4 is a unique section because there are no existing dikes. In this section, the existing channel would be stabilized in some areas to promote a single thread channel. Floodplain flows would be unrestricted in Reach 4. A 65-foot wide channel section would be essential to maintain sediment transport conditions consistent with upstream and downstream reaches, and the floodplain width would range from 600 to 1,000 feet. Channel design in Reach 4 would utilize the existing active channel features as much as possible. Changes in proposed alignment and profile would be necessary during final design to maximize utilization of active channel features because the channel is expected to continue to shift in the future as it adjusts to changed upstream conditions.

Reach 9 typically would incorporate a wider channel cross-section (80 foot top-width in riffles, 100 foot top-width in pools) to reduce the scour potential of the sediment-free or "hungry" water releases from Jordanelle Reservoir.

1.8.2 Floodplain Features

Where a rapid-pool channel cannot be constructed within the confines of the existing dikes, the dikes either would be removed and subexcavated to develop the required 100-year flood capacity, or low relief setback dikes would be constructed. Setback dikes would have a typical height of 2 to 4 feet and a top width of 15 feet, as shown in Figure 1-3 in Section 1.7. Wider top-widths would not be used for this alternative because the setback dikes would be located near the river channel rather than in pastures or other agricultural lands. Every effort would be made to minimize disturbance of significant riparian habitat where existing dikes would be removed and setback dikes would be constructed.

In limited locations where dikes would be relocated outward from the channel as part of the Existing Channel Modification Alternative, the existing (under baseline conditions) public access corridor would be expanded so it would incorporate the new dike. This would occur in Reaches 2 and 3. The public access corridor would serve as a major portion of the construction easement during construction of the Existing Channel Modification Alternative features. Minor construction easements would be required in addition to the existing federal construction easements, even with the expanded public access corridor. Where the channel is immediately adjacent to a steep hillside (e.g., the lower portion of Reach 7), the construction easement would consist of 100 feet on the valley side of the channel. Fencing requirements for newly acquired public lands would be the same as described in Section 1.7.2.6. Map A-8 in the map pocket at the back of the EIS shows proposed public access and construction easement areas for the Existing Channel Modification Alternative. Additional information on assumptions related to land ownership and property acquisition is presented in Section 1.11.1.

1.8.3 Construction Procedures

1.8.3.1 Typical Construction Procedures

Construction of the Existing Channel Modification Alternative would proceed from upstream to downstream, with a cofferdam (see Section 1.7.3.1) used to keep portions of the existing channel area dry during construction. The cofferdam would be placed near the center of the channel to isolate one side of the river channel and bank from active flow. A small settling pond would be created at the downstream end of the section under construction. After construction is completed on one side of the channel, flow would be introduced to it gradually to wash out loose sediment and allow it to settle out and be removed from the settling pond. Then the river flow would be turned into the completed section, and channel construction would proceed on the opposite of the river. After work has been completed on one construction segment, the cofferdam would be moved downstream to the next construction segment.

Salvageable materials from the existing channel would be sorted and stockpiled on site for use in new channel construction. Salvageable materials include boulders and large rocks from the existing levees; river cobble from the existing river bottom; woody material from existing vegetation on the banks (root wads, tree trunks and large branches); and topsoil.

Timing of construction would be scheduled such that, to the extent possible, construction in the existing channel itself would not occur during the high flow period in May through July. Depending on hydrologic conditions and Jordanelle Reservoir levels, Jordanelle Reservoir water releases could be reduced during construction to facilitate equipment ingress/egress and construction activity. No plan for this has been developed at this time, and any such plan would have to be approved by downstream irrigators, other water rights holders and environmental agencies, and would have to satisfy all water rights obligations.

Jordanelle Reservoir water releases would be managed for approximately 5 years following construction to prevent the occurrence of severe flows. This would allow vegetation to become well-established along the channel banks. Minor flooding would be allowed outside the channel to encourage the development of riparian vegetation in the floodplain. A specific reservoir management plan has not been formulated at this time, and would be dependent on reservoir storage conditions at the time of construction.

Construction equipment and stockpiling procedures for the Existing Channel Modification Alternative would be the same as those described in Section 1.7.3.1 for the Proposed Action. In addition, stockpiling, staging and construction activity areas would be confined as much as possible to the side of the channel where setback dikes would be constructed to minimize adverse impacts on existing riparian vegetation.

Existing utilities crossing the river are suspended and would be protected in place during and after construction.

1.8.3.2 Typical Noise Levels and Air Emissions

Typical noise levels and air emissions for the construction equipment required to construct the Existing Channel Modification Alternative are presented in Tables 1-8 and 1-9 in Section 1.8.2.3 of the WCWEP and DRP EIS.

1.8.3.3 Temporary Construction Access

Temporary construction access issues for the Existing Channel Modification Alternative would be the same as described in Section 1.7.3.3 for the Proposed Action.

1.8.4 Maintenance Procedures

Maintenance procedures for the Existing Channel Modification Alternative would be the same as described in Section 1.7.4 for the Proposed Action.

1.9 Instream Structures Alternative — Physical Features and Other Characteristics

Clearwater BioStudies, Inc. prepared an Aquatic Habitat Improvement Plan for the Provo River below Jordanelle Dam (Clearwater BioStudies, Inc. 1991). This plan, prepared for the U.S. Forest Service (USFS), identified habitat enhancement structures suitable for use in the present channel. The assumptions for the Aquatic Habitat Improvement Plan were established to be consistent with the requirements of the Aquatic Mitigation Plan for the Strawberry Aqueduct and Collection System. The plan developed by Clearwater BioStudies, Inc. serves as the basis for the Instream Structures Alternative. More specific details for accomplishing the habitat improvements would be developed in final design of this alternative.

The Instream Structures Alternative would include minor modifications to localized features in the Provo River. No modifications would be made to the channel, cross-section or alignment, levees, floodplains, diversion structures or bridges for the purpose of river restoration. Fish habitat structures would be constructed within the existing river channel. Table 1-8 summarizes the improvements of the Instream Structures Alternative by reach. Map 1-2 in Section 1.3.4 shows portions of the river reaches where the Instream Structures Alternative would be implemented. The PRRP Technical Report (CUWCD 1994a) refers to this alternative as the No Action Alternative. Angler access would be provided along the river corridor as part of baseline conditions; additional public access would not be acquired under this alternative.

1.9.1 Channel Features

This alternative would consist of installing a variety of fish habitat enhancement structures in the existing Provo River channel. Based on detailed field investigations, 233 site-specific enhancement measures were designed to address habitat limitations within the Provo River corridor. These measures are distributed among a total of 16 stream sections (subreaches) within PRRP Reaches 2, 3, 5, 6, 7, 8, and 9. No structures were proposed for Reach 1 because the current habitat is fair to good, and the channel is moderately unstable because of Deer Creek Reservoir backwater effects and periodic inundation by the reservoir pool. Reach 4 was not considered amenable to habitat enhancement because of channel instability and the existing multiple channel features.

The overall habitat enhancement plan consists of 70 cover logs, 11 depositional structures, 2 logs with root wads, 17 "organic riprap" treatments, 54 sets of rock clusters, 24 rock deflectors, 7 rock weirs, 46 rock diagonals, 1 rock diagonal with a wing, and 1 excavation treatment. Sketches of several of the more common habitat enhancement structures are shown in Figures 1-6 to 1-9. Plans for locating and constructing these structures are included in the Aquatic Habitat Improvement Plan for the Provo River below Jordanelle Dam (Clearwater BioStudies, Inc. 1991). The objectives of these various structures would be to provide new pool habitat, hiding cover, high flow refuge areas, scour holes, and spawning habitat for trout, as well as providing a minimum level of channel erosion control. Final design would incorporate modifications from this plan as required to meet conditions in the channel when the project is implemented. Certain structures may be dropped from implementation based on experience and agency preference.

Table 1-9 presents a summary of channel and floodplain characteristics under the Instream Structures Alternative. Under this alternative channel width and depth are defined by the presence of the existing dikes. Discharges up to or in some areas exceeding the 100-year peak discharge are contained within the dikes with no overbank/floodplain flows, except in Reach 4 which has no dikes. Table 1-9 shows average channel velocities for the Instream Structures Alternative throughout a range of design flows.

The Instream Structures Alternative would not involve modifications to diversion dams or headgates. It is assumed that diversion modifications necessary to accommodate the minimum instream flow requirement would be made as part of baseline conditions.

1.9.2 Public Access

The seven public access points shown in Map 1-2 in Section 1.3.4 and an access corridor along the entire existing river channel would be developed under baseline conditions. No new public access corridor areas beyond baseline would be acquired for the Instream Structures Alternative. Fencing requirements for newly acquired public lands would be the same as described in Section 1.7.2.6 and would be implemented under baseline conditions.

1.9.3 Construction Procedures

1.9.3.1 Typical Construction Procedures

Construction activities would be conducted with a minimum of disturbance on the existing channel and adjacent areas. Only light mechanical equipment (e.g., backhoe, small dozer, track-mounted excavator, truck for hauling large rock) would be required for placement of habitat structures after materials have been delivered to the site.

Typical construction procedures would consist of first staking locations of proposed habitat structures, or marking locations on existing trees, boulders, etc. Some of this surveying was accomplished in 1991 as

Table 1-8
Summary of Instream Structures Alternative Improvements

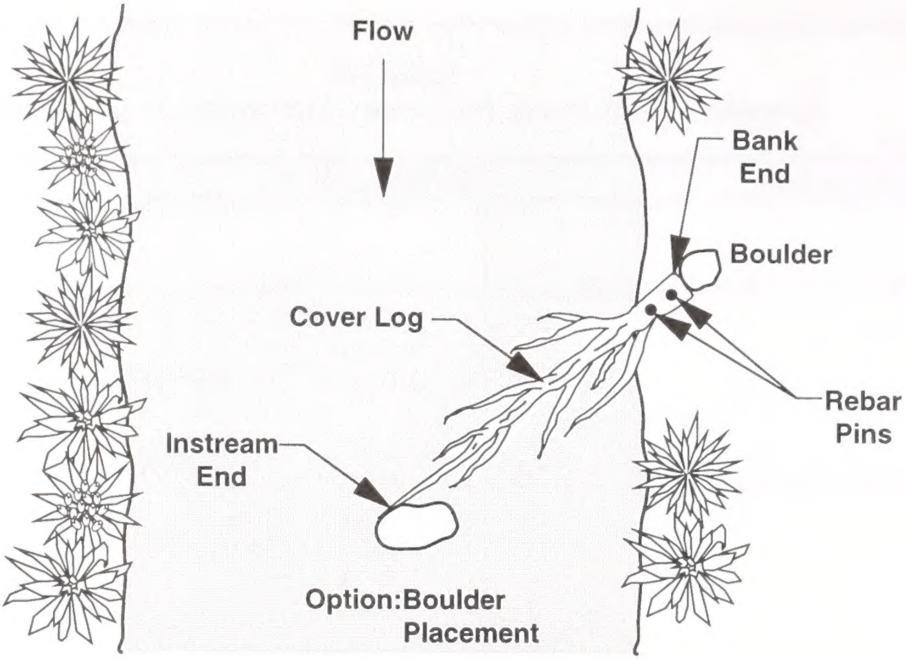
Page 1 of 2

PRRP Study Reach	Improvements
Reach 1 Deer Creek Reservoir to End of Levees	• No Improvements
Reach 2 End of Levees to Casperville	• 8 Rock Diagonals • 1 Rock Diagonal with Wing • 7 Rock Clusters • 3 Rock Deflectors • 16 Cover Logs
Reach 3 Casperville to Island Ditch Diversion	• 8 Rock Diagonals • 9 Rock Clusters • 7 Rock Deflectors • 23 Cover Logs • 2 Organic Rip-Rap Treatments
Reach 4 Island Ditch Diversion to End of Levees	• No Improvements
Reach 5 End of Levees to Probst Diversion	• 6 Rock Diagonals • 6 Rock Clusters • 2 Rock Deflectors • 5 Cover Logs • 4 Organic Rip-Rap Treatments
Reach 6 Probst Diversion to River Road	• 17 Rock Diagonals • 15 Rock Clusters • 8 Rock Deflectors • 11 Cover Logs • 8 Organic Rip-Rap Treatments • 6 Depositional Structures • 1 Excavation Treatment
Reach 7 River Road to Baum Diversion	• 6 Rock Diagonals • 8 Rock Clusters • 1 Rock Deflector • 4 Rock Weirs • 5 Cover Logs • 2 Depositional Structures

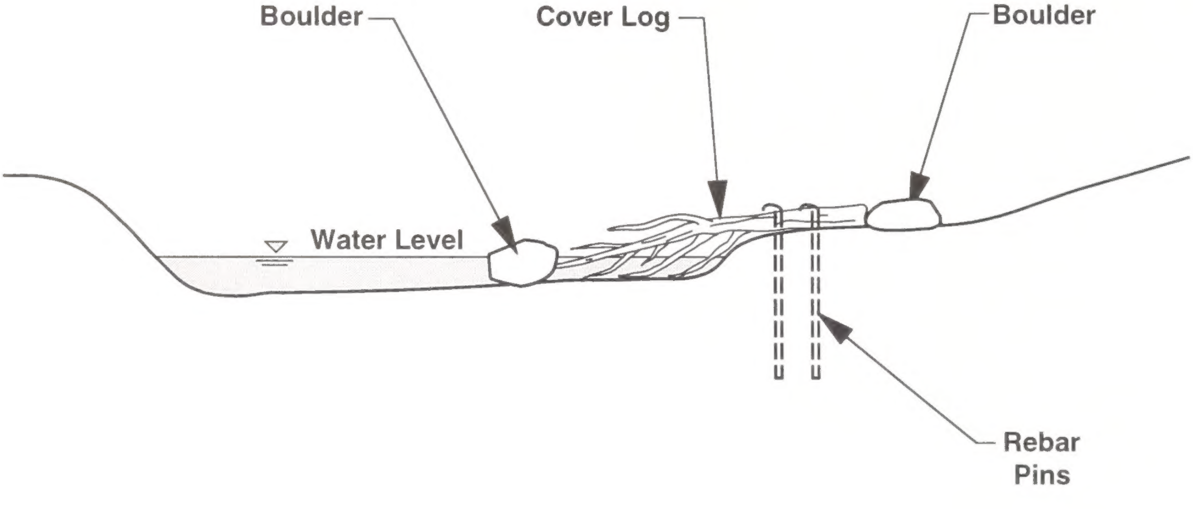
Table 1-8
Summary of Instream Structures Alternative Improvements

Page 2 of 2

PRRP Study Reach	Improvements
Reach 8 Baum Diversion to Valeo Diversion	• 1 Rock Cluster • 1 Rock Deflector • 5 Cover Logs • 2 Organic Rip-Rap Treatments
Reach 9 Valeo Diversion to Old U.S. 40	• 1 Rock Diagonal • 8 Rock Clusters • 2 Rock Deflectors • 3 Rock Weirs • 5 Cover Logs • 1 Organic Rip-Rap Treatment • 3 Depositional Structures • 2 Logs with Rootwad



View from Above



Cross-Section View

Figure 1-6
Fish Habitat Enhancement Cover Log Structure

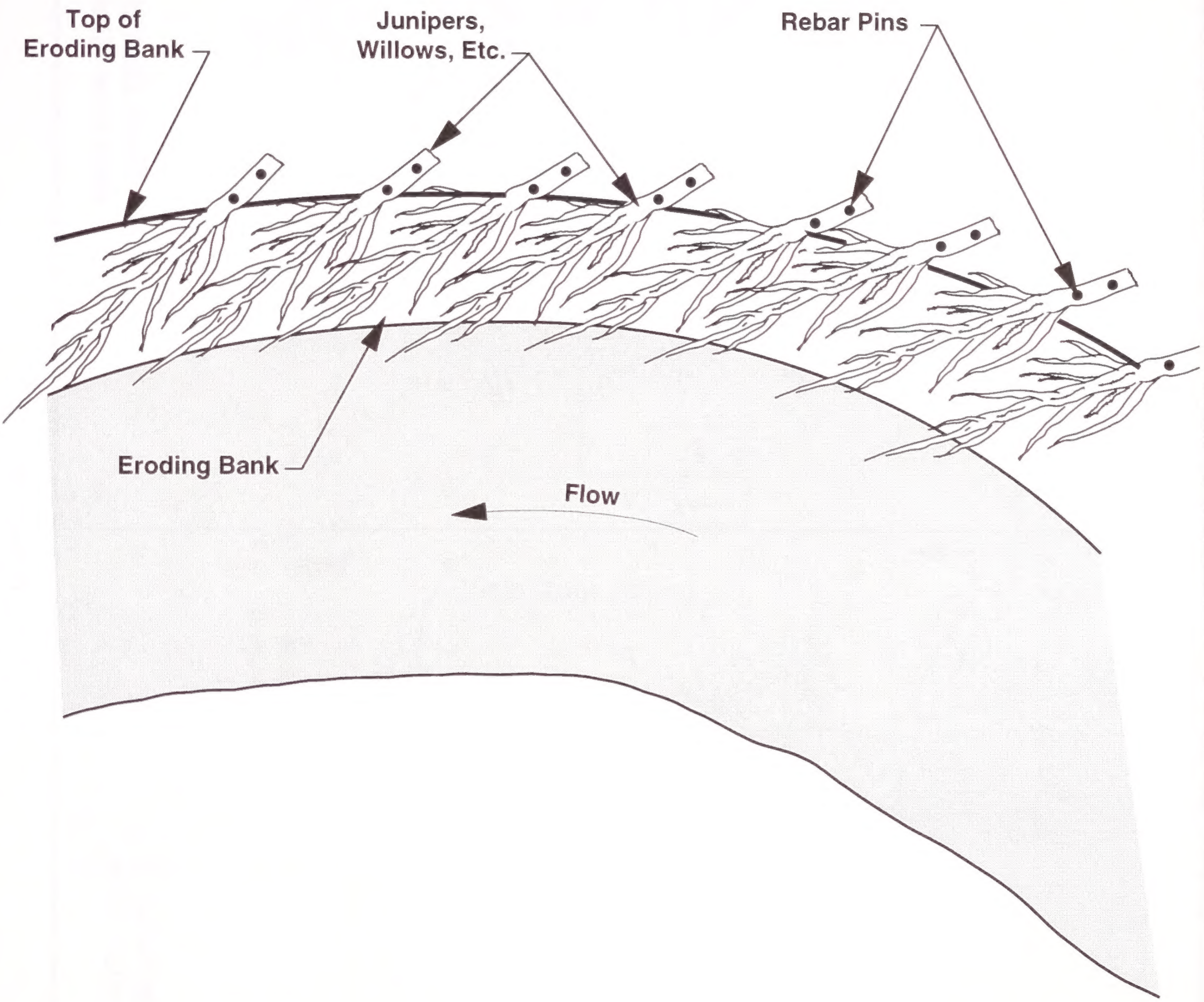
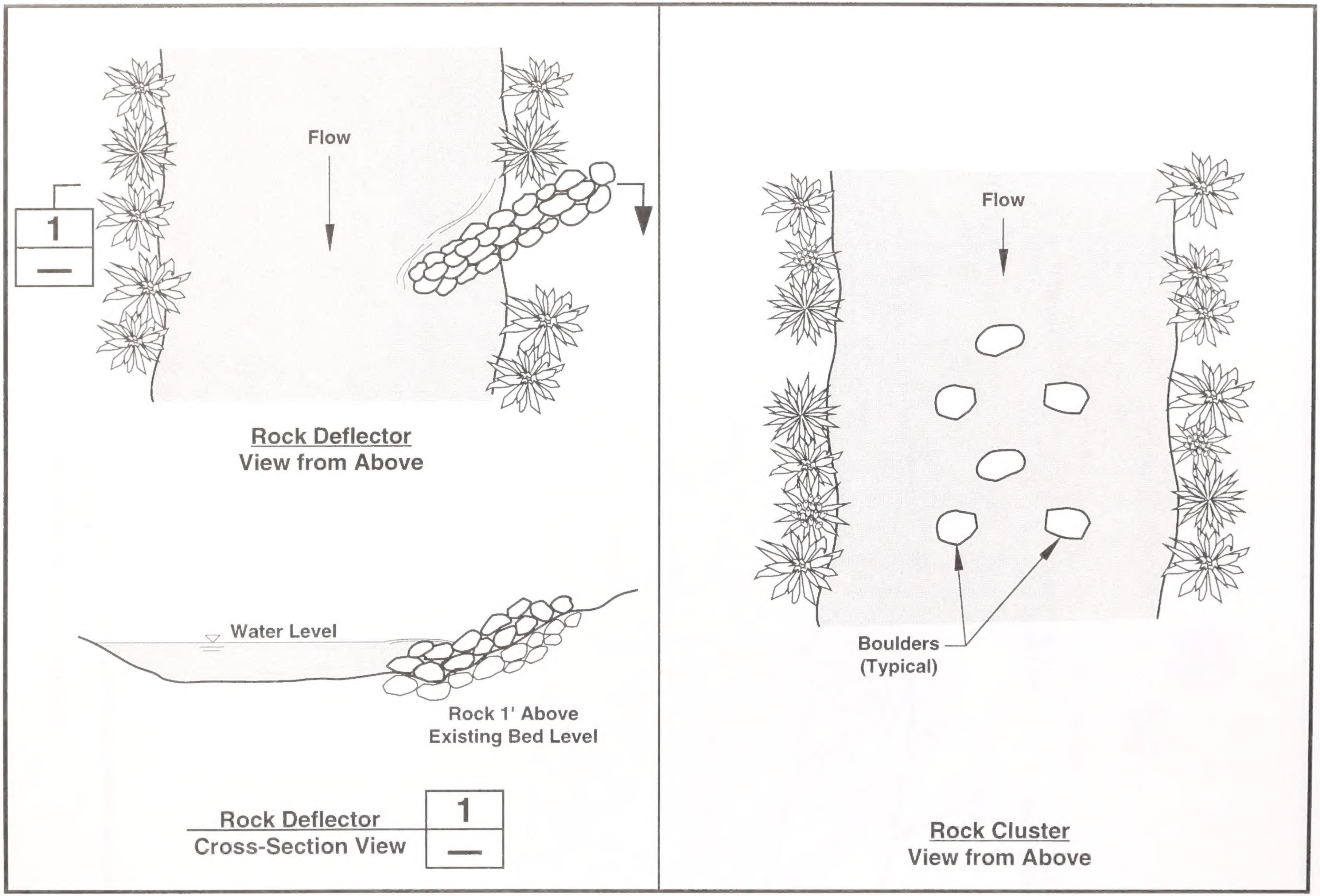


Figure 1-7
Schematic of Organic Riprap After Reconstruction

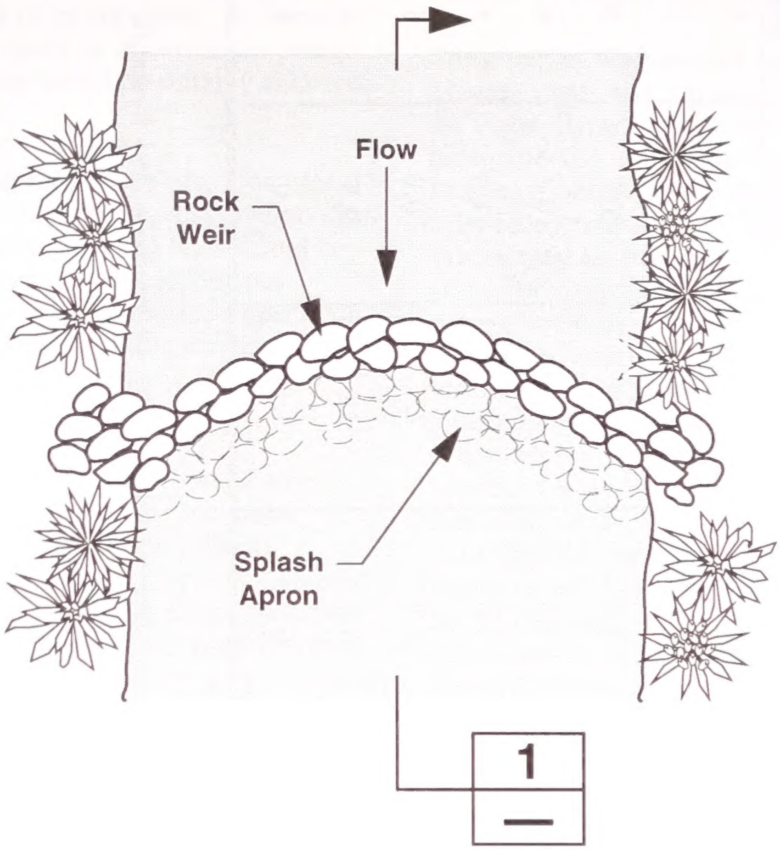


Rock Deflector
View from Above

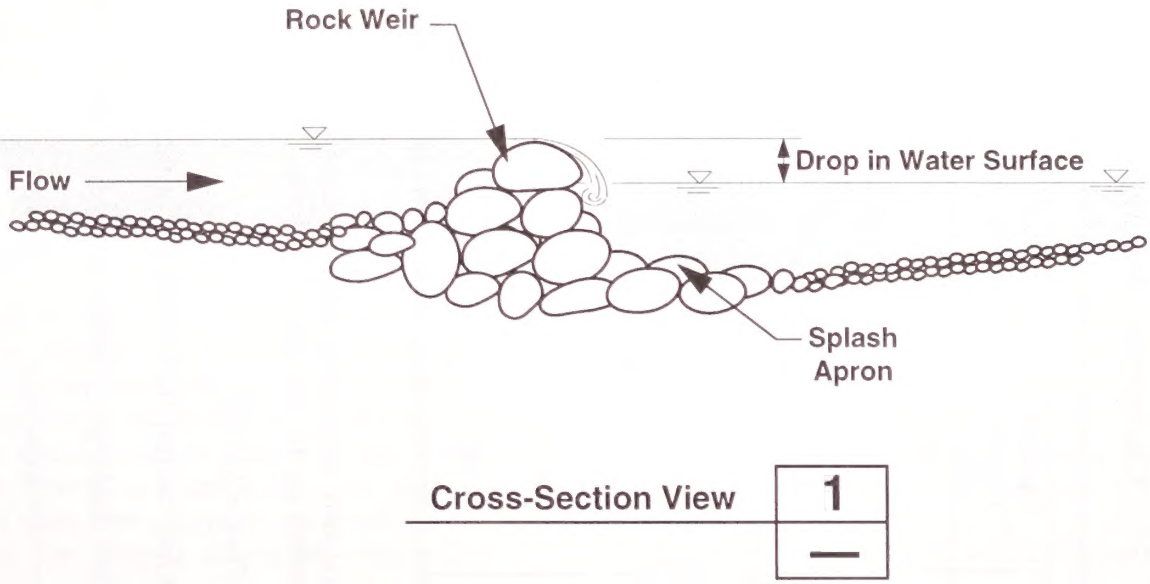
Rock Deflector
Cross-Section View

Rock Cluster
View from Above

Figure 1-8
Schematic of Rock Deflector and Rock Cluster



View from Above



Cross-Section View

Figure 1-9
Schematic of Rock Weir

Table 1-9
Channel and Floodplain Reach Characteristics Under the Instream Structures Alternative

						Mean Channel Velocity		
Reach	Channel Length (ft)	Bankfull Width (ft)	Floodplain Width (ft)	Channel Slope (ft/ft)	Bankfull Depth (ft)	Base Flow (ft/sec)	Bankfull Discharge (ft/sec)	100-year Discharge (ft/sec)
2	5,500	70	N/A	.005	7.1	2.1	7.0	6.5
3	7,510	80	N/A	.006	6.0	2.4	7.6	6.6
4	6,920	120	600	.008	3.0	2.9	6.5	5.0
5	4,440	100	N/A	.010	7.0	3.2	10.5	6.8
6	8,720	90	N/A	.011	7.0	2.5	11.0	7.2
7	4,730	80	N/A	.011	7.0	2.7	10.0	6.9
8	4,600	110	N/A	.009	6.1	3.0	9.9	6.5
9	8,460	80	N/A	.010	6.0	3.1	9.0	8.0

Notes:

1. A persistent and well-defined riffle/pool sequence does not exist under baseline conditions; the geomorphic and hydraulic parameters are for average conditions. Their location is most closely classified as a "run".
2. Base Flow = 125 cfs.
3. "Bankfull" corresponds to the top of the existing levees.
4. Bankfull discharges generally exceed the post-Jordanelle 100-year peak discharge.
5. N/A = Not applicable.

part of the Clearwater BioStudies, Inc. project, but it may have to be verified or re-surveyed. Structure locations would not be exact as shown in the design plans as long as structures could be suitably anchored in place.

Larger construction materials (boulders, logs, trees) would be stockpiled as close to the construction sites as possible. Selection of stockpiling sites would be accomplished in coordination with landowners, agencies, or the contractor to minimize impacts on existing land uses. Smaller materials may be stockpiled at the USBR facility below Jordanelle Dam for later use by construction crews.

Boulders comprising certain rock structures may have to be cabled to one another for increased structural stability. Logs protruding into the channel would have to be cabled to trees or boulders on the bank, or pinned to the bank or channel bars. When cabling logs to live trees, shims would be used to protect the tree. Rebar up to 8 feet long would be used to pin logs in place.

Construction would not affect existing utilities. This alternative would not involve major excavation, and all utilities crossing the Provo River are suspended rather than buried.

Construction would be scheduled to occur only during low flow periods, which generally last from August through April during a normal hydrologic year. Minor temporary in-channel diversions would be constructed using river bottom material as necessary to accommodate construction activities in the channel.

1.9.3.2 Typical Noise Levels and Air Emissions

Table 1-8, Section 1.8.2.3 in the WCWEP and DRP EIS defines typical noise levels that would be associated with operation of numerous types of equipment during construction. Backhoes, dozers, and haul trucks would be used to construct the Instream Structures Alternative. Not more than two pieces of each type of equipment would be in operation concurrently during the construction period.

Table 1-9, Section 1.8.2.3 in the WCWEP and DRP EIS defines typical air emissions associated with various types of construction equipment.

1.9.3.3 Temporary Construction Access

Construction workers and equipment would use existing roads and rights-of-way to gain access to the Provo River. Requests would be made of certain landowners to access the river or private roads. Federal property and federal construction easements exist along nearly all of the PRRP river corridor. Where they exist, these federal easements would allow for construction of Instream Structures Alternative project features. Maps A-5 and A-6 in the map pocket at the back of the EIS show locations of existing federal land parcels. The remainder of the river corridor would be acquired for public access under baseline conditions. The access corridor would serve as the construction zone for this alternative. Even without acquisition of the river corridor for public access, the only location where an additional construction easement would have to be acquired to install fish habitat enhancement structures is in the upper portion of Reach 4, where the existing easement allows only for flood inundation.

1.9.4 Maintenance Procedures

The proposed fish habitat enhancement structures would be susceptible to damage or complete washout from the high velocities and erosive conditions prevalent in the existing confined channel. Cabled logs could be dislodged and washed downstream; boulders could be buried with coarse bedload; and organic bank protection could be eroded away from the high channel velocities during peak flows. The highly mobile cobble channel bed would make permanent anchoring of the structures difficult.

Maintenance procedures would consist of annual inspections and replacement of damaged structures. Instream structures would be visually inspected each year after the peak spring runoff period. Most damage would be expected to occur during this high flow period. During inspection, a decision would be made on whether a replacement structure would be viable in the same location; a different type of structure should be tried; or a new structure should be installed in a different location. The Mitigation Commission would be responsible for maintaining instream structures.

Maintenance of irrigation structures would continue to be the responsibility of the irrigation companies or private irrigators. It is assumed that required modifications to maintenance and repayment contracts between Provo River Water Users Association and the Bureau of Reclamation associated with Jordanelle Reservoir impacts on river hydrology and operation of the existing diversion structures would be completed as part of baseline conditions.

1.10 No Action Alternative

Implementation of the No Action Alternative would not stabilize the Provo River's bed and banks, restore the riverine habitat or improve instream fish habitat. The needs defined in Section 1.2 would not be met and baseline conditions would continue, including annual maintenance of dikes and diversions along the Provo River.

Commitments included in the M&I System EISs (and defined in Section 1.11 of the WCWEP and DRP EIS) would be implemented under baseline conditions and their related effects would continue under the No Action Alternative.

1.11 Summary of Other Characteristics

1.11.1 Changes in Land Use and Ownership

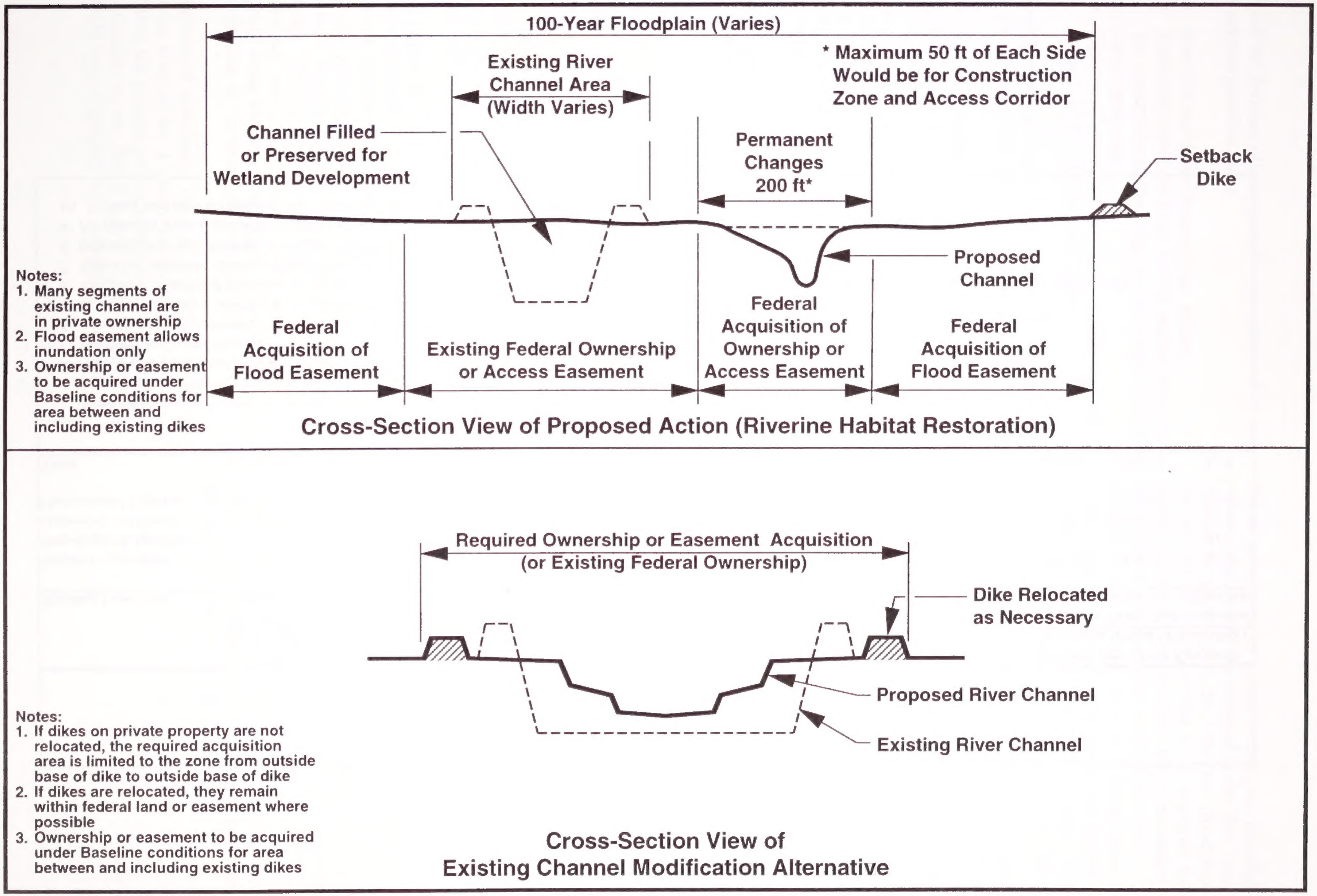
Implementation of the PRRP Proposed Action, or any alternative except the No Action Alternative, would result in changes in land ownership and land use. Construction activities would cause temporary changes lasting 1 to 3 years. Acquisition of additional land — beyond that acquired for baseline conditions — for placement of new features would cause permanent changes. These features include new river channel, additional side channels, ponds, and access corridors along the new river channel. All the land within the baseline corridor would be incorporated into the revised project and public access corridor. Figure 1-10 is a schematic showing typical land acquisition requirements.

Table 1-10 lists acres temporarily disturbed, permanently removed and encumbered by flood easement under the Proposed Action and PRRP alternatives. The existing land use categories are defined in Section 1.12.1 of the WCWEP and DRP EIS.

Descriptions of land use and ownership changes for the Proposed Action and PRRP alternatives assume that baseline conditions consist of acquisition of a public access corridor along the entire existing Provo River channel between Jordanelle and Deer Creek reservoirs. The objectives of the project corridor would be to: 1) provide public access to the Provo River and related features; 2) provide construction and maintenance access to project features; 3) provide a defined, fenced public access area to protect adjacent private properties from unlawful trespass; and 4) exclude cattle to protect the resource. It has been assumed that this public access corridor would include the channel area plus up to 50 feet on each side of the channel; it would, however, be limited to existing fence lines and property lines near the outside toe of the existing dike where they currently exist. It has been assumed that this public access corridor would be acquired in fee title or permanent easement as part of baseline conditions, prior to implementing the Proposed Action or the PRRP alternatives. For the most part, the baseline public access corridor would lie within the current federal construction easement boundaries along the river. Although the United States currently has authority to construct any project features within the existing federal construction easements along the channel, title to or easements on private areas in the river corridor would be acquired to protect the resources developed under the PRRP and make it available to the public.

Under the Proposed Action and PRRP alternatives, the additional right-of-way to be acquired for public access (i.e., beyond baseline) would consist of the new channel itself, and a typical 50-foot wide strip along each side of the channel, which could include the retained dikes. In locations where access or construction would be restricted on one side of the channel (e.g., by steep hillsides), a 100-foot access right-of-way would be acquired on the unobstructed side of the channel. Any off-channel aquatic features such as ponds or side channels that would be developed in the future on private property would necessitate 50-ft similar property or easement acquisition zones. A permanent construction easement would be acquired for setback dikes; if feasible, agricultural land uses could continue over these facilities as long as they are not damaged.

The property required for public access and project construction and maintenance (for the baseline and the PRRP) along the constructed river corridor


100-Year Floodplain (Varies)
Existing River Channel Area (Width Varies)
* Maximum 50 ft of Each Side Would be for Construction Zone and Access Corridor
Channel Filled or Preserved for Wetland Development
Permanent Changes 200 ft*
Setback Dike
Proposed Channel
Federal Acquisition of Flood Easement
Existing Federal Ownership or Access Easement
Federal Acquisition of Ownership or Access Easement
Federal Acquisition of Flood Easement
Required Ownership or Easement Acquisition (or Existing Federal Ownership)
Dike Relocated as Necessary
Proposed River Channel
Existing River Channel

Cross-Section View of Proposed Action (Riverine Habitat Restoration)

Notes:
1. Many segments of existing channel are in private ownership
2. Flood easement allows inundation only
3. Ownership or easement to be acquired under Baseline conditions for area between and including existing dikes

Cross-Section View of Existing Channel Modification Alternative

Notes:
1. If dikes on private property are not relocated, the required acquisition area is limited to the zone from outside base of dike to outside base of dike
2. If dikes are relocated, they remain within federal land or easement where possible
3. Ownership or easement to be acquired under Baseline conditions for area between and including existing dikes

Figure 1-10
Schematic of Typical PRRP Property Requirements

Table 1-10
Areas to be Temporarily Disturbed, Permanently Removed, and Encumbered by Flood Easement Under the Proposed Action and PRRP Alternatives

	Acres Temporarily Disturbed and Reclaimed to Present Use / Project Use			Acres Permanently Removed by Project Features			Acres Permanently Converted to or Protected for Wildlife Habitat			Acres with New Flood Easement (Construction+Flood / Flood-Only)		
Existing Land Uses	Proposed Action	Exist Chnl Mod Alt	Instream Struc Alt	Proposed Action	Exist Chnl Mod Alt	Instream Struc Alt	Proposed Action	Exist Chnl Mod Alt	Instream Struc Alt	Proposed Action	Exist Chnl Mod Alt	Instream Struc Alt
Irrigated Agriculture	9.4 / 63.1	0.7 / 21.7	0.7 / 0.0	29.7	0	0	148.9	7.6	0	156.5 / 56	4.0 / 0	0 / 0
Non-Irrigated Agriculture	1.2 / 10.6	0.0 / 0.0	0.0 / 0.0	3.9	0	0	20.6	0	0	2.7 / 10.2	0 / 0	0 / 0
Undeveloped Upland	72.8 / 0.0	2.2 / 0.0	0.0 / 0.0	24.6	20.3	0	105.2	0	0	21.4 / 54.5	10.1 / 0	0 / 0
Undeveloped Riparian	137.9 / 0.0	130.5 / 0.0	0.0 / 0.0	38.8	3.9	0	9.5	0	0	0 / 0	0 / 0	0 / 0
Total	**221.3 / 73.7**	**133.4 / 21.7**	**0.7 / 0.0**	**97.1**	**24.2**	**0**	**284.2**	**7.6**	**0**	**180.6/120.7**	**14.1 / 0**	**0 / 0**

Notes:

1. Acres Reclaimed to Present Use are agricultural lands outside the with-project public access corridor and on undeveloped lands anywhere in the project area.
2. Acres Reclaimed to Project Use are agricultural lands inside the with-project access corridor and thus can be reclaimed to wildlife habitat but not agricultural uses.
3. Acres Temporarily Disturbed and Reclaimed are impacted by construction roads, construction zone and stockpile areas, graded floodplains, setback dikes, and filled abandoned channel.
4. Acres Permanently Removed by Project Features are impacted by main channel, side channel, pond and setback dikes features anywhere in the project area.
5. Acres Permanently Converted to or Protected for Wildlife Habitat is new land acquired for access corridor.
6. Acres with New Flood Easement are divided into areas with an easement allowing for construction and flooding, and areas with an easement allowing for flooding only.
7. Exist Chnl Mod Alt - Existing Channel Modification Alternative
8. Instream Struc Alt - Instream Structures Alternative
9. All federally owned land along the river corridor is categorized as Undeveloped Riparian or Undeveloped Upland
10. Existing land uses are based on the 1991 Wasatch County map "Water-Related Land Uses"

would be permanently acquired or encumbered in one of several possible ways:

- Fee title purchase from willing sellers
- Easement purchase from willing sellers allowing for construction, flooding, and/or public access
- Land exchanges
- Eminent domain/condemnation (only as a last resort) of fee title or easements

Specific options would be investigated on a parcel-by-parcel basis with each individual property owner.

Construction vehicles and equipment would use temporary access roads to move from existing public roads to construction areas throughout the impact area of influence. The majority of these roads would be situated along the existing and proposed channel alignments or along the existing dikes, and would become part of the area acquired for public access and other project features. Land uses of all types would be temporarily restricted on access roads during construction. Existing and planned land uses could resume after construction on access roads not in the ultimate acquisition area.

The Instream Structures Alternative could be fully constructed and maintained within the existing property and easements owned by the United States, even without the public access corridor acquisition assumed for baseline conditions. However, remaining non-federal lands on the river would have to be acquired in fee title, or would have to be encumbered with a public access easement, to satisfy the public access requirements of the Bonneville Unit M&I System EISs.

All public angler and construction access corridor areas would be fenced to exclude livestock from natural resource areas and to protect surrounding private property from the public. The type and style of fencing would be determined during final design. Provisions would be made for allowing livestock crossing or access zones through the fenced areas where this would be required by the landowner to continue grazing activities.

Sections of abandoned channel that would be filled to the level of the adjacent floodplain would remain within the project public access corridor, with the restriction on use that it would entail. Filled areas would be revegetated with indigenous vegetation.

Flood easements, to permit occasional flooding of private land, would be obtained under the Proposed Action for portions of the 100-year floodplain that are outside the river corridor to be acquired for public access or construction. Flood easements would allow any land uses compatible with occasional inundation. Map A-9 in the map pocket at the back of the EIS shows projected locations of 2-year, 10-year and 100-year flood areas. The 2-year floodplain would be inundated on average once every two years with 50 percent chance of inundation in any year; the 10-year floodplain would be inundated on average once every 10 years with 10 percent chance of inundation in any year; and the 100-year floodplain would be inundated on average once every 100 years with one percent chance of inundation in any year. Typical 100-year floodplain depths would be 0.5 to 1.5 feet; typical floodplain velocities would be about 1.0 feet per second. Duration of inundation would be determined by releases from Jordanelle Dam. The duration of peak discharge releases from the dam would be from one to seven days; inundation in the floodplain could be expected to last for about one week beyond the peak release period for the 100-year flood, and for shorter periods during smaller floods. Future urban development in the 100-year floodplain would be regulated by Wasatch County floodplain management ordinances. Inhabitable structures would be required to be elevated (e.g., on fill material) above the 100-year flood water surface level.

Table 1-11 lists PRRP rights-of-way acquisition under the Proposed Action and alternatives. Ownership changes would be associated with purchase of fee title by the United States government but not with purchase of access, construction or flood easements. Private property owners would be compensated at the fair market value of the land. No land owned by local cities, Wasatch County, or the State of Utah would be acquired for project right-of-way because none is required for any of the project alternatives. All of Reaches 8 and 9 are in federal ownership, therefore no property or easement acquisition is required in the upper 2.5 miles of the PRRP.

Table 1-11
PRRP Rights-of-Way Acquisition Under the Proposed Action and Alternatives

Reach	Public Access Acquisition (acre)	Construction Easement Acquisition (acre)	Flood Easement Acquisition (acre)
Proposed Action (Riverine Habitat Restoration)			
Reach 2	73.5	42.6	44.9
Reach 3	16.5	27.6	28.5
Reach 4	47.3	17.5	0
Reach 5	38.9	27.2	25.6
Reach 6	86.9	61.5	20.3
Reach 7	21.1	4.2	1.4
Reach 8	0	0	0
Reach 9	0	0	0
Total	**284.2**	**180.6**	**120.7**
Existing Channel Modification Alternative			
Reach 2	5.7	1.8	0
Reach 3	1.9	0	0
Reach 4	0	10.1	0
Reach 5	0	0.7	0
Reach 6	0	1.5	0
Reach 7	0		0
Reach 8	0		0
Reach 9	0		0
Total	**7.6**	**14.1**	**0**
Instream Structures Alternative	0	0	0

Notes:

1. Public access area could be acquired in fee title or as an easement.
2. All non-federal land to be acquired is currently in private ownership.
3. Public access area would be fenced.
4. All acreages are in addition to baseline corridor.

1.11.2 Construction Schedule and Number of Workers

Figures 1-11, 1-12, and 1-13 show monthly construction schedules and average number of workers for the Proposed Action, Existing Channel Modification and Instream Structures alternatives.

The Proposed Action would be constructed during a period of about 67 months. A maximum of 25 workers would be on-site at any time, with an average work force of 15. Construction would proceed in a downstream direction. Right-of-way would be acquired on a reach-by-reach basis because implementation and subsequent monitoring of the performance of initial project phases may result in design changes for downstream reaches that could alter specific property requirements. The level of work effort would not diminish through the spring and early summer high flow period, but work would be shifted to off-channel features such as new channel meanders, side channels, ponds, setback dikes, etc.

The Existing Channel Modification Alternative would be constructed during a period of about 48 months. A maximum of 25 workers would be on-site at any time, with an average work force of 15. After an initial waiting period for right-of-way acquisition, construction would be phased in an upstream-to-downstream direction. Work effort would be lightest during the seasonal high flow period, when in-channel activities would be curtailed.

The Instream Structures Alternative would be constructed during a period of five months with an average of six workers on-site throughout construction. All work would be accomplished during a single low water (fall and winter) construction period.

1.11.3 Employment Opportunities

Table 1-12 shows employment opportunities and estimated pay rates for construction and maintenance of the Proposed Action and alternatives. The project would employ both skilled and unskilled workers. Similar types of workers would be required for each alternative. It is assumed that 75 percent of the contractor's labor force would be non-county residents from the Salt Lake City, Provo, and Orem areas. The remaining 25 percent would be Wasatch County residents. The Mitigation Commission would be responsible for conducting or contracting for maintenance activities.

1.11.4 Transportation Requirements

Table 1-13 lists construction transportation requirements for the Proposed Action and alternatives. Construction management staff and workers would use pickup trucks and other passenger vehicles to commute to the project site. The estimated number of round trips is based on an occupancy rate of one person per vehicle. Approximately 75 percent of the contractor work force and nearly all the construction management staff would commute to the site from outside of Wasatch County. Commuters traveling from Salt Lake City would use Interstate 80 and U.S. 40. Commuters from the Provo-Orem area would use State Route 189 through Provo Canyon.

Rock haul trips in Table 1-13 only include bringing rock to the site from offsite borrow areas. This only would be required under the Instream Structures Alternative. Rock needed in the other alternatives would be salvaged from the existing levee riprap.

The Proposed Action and Existing Channel Modification Alternative would generate large quantities of waste material resulting from channel excavation. Although salvageable material (e.g., boulders, river cobble, woody material, topsoil) would be sorted and stockpiled on site, large amounts of unclassified dirt, rock and vegetation debris would be hauled offsite for disposal. It is currently proposed that waste material would be hauled to the large material extraction area in Heber Valley east of State Route 189 near the community of Charleston (northeast corner of USGS Section 23). A large pit is being developed at this site into which PRRP waste material could be dumped and then sorted and processed for use as construction materials. The processed material would be distributed to the various quarry customers, and the unusable material would be disposed along with the normal waste material from the quarry operation. Other quarry sites in Heber Valley could be used in a similar fashion for their sorting, processing and distribution capabilities. It is possible that some of the processed materials (e.g., crushed gravel) could be used to help construct the WCWEP and DRP facilities.

1.11.5 Materials Used During Construction

Table 1-14 lists construction material requirements for the Proposed Action and alternatives. The principal materials used for channel construction would be large rock, river cobbles, and vegetative material (e.g., transplants, root wads). The majority of these materials would be supplied from onsite sources made available through other aspects of the construction project. Material requirements exceeding salvage quantities would be filled using local quarries, seed suppliers, etc. Relatively small amounts of concrete and steel would be used in reconstructing diversions. A large amount of fencing would be installed along the river corridor for the Proposed Action and Existing Channel Modification Alternative. The type of fencing has not been determined. The Instream Structures Alternative would use about 116 large logs for fish habitat structures. Geotextile fabric would be used to control surface and channel bank erosion in selected areas for the Proposed Action and Existing Channel Modification Alternative.

A large amount of spoil material would be generated during construction. Disposal of this material is discussed in the previous section.

1.11.6 Projected Project Life and Costs

The Proposed Action and the Existing Channel Modification Alternative would be designed as self-sustaining natural systems once riparian bank stabilization has been established. Although channel geometry, alignment and other aspects of the riparian system may adjust over time in response to changing hydrology, watershed land use, etc., the overall integrity of the system would not deteriorate. The only elements of the project which would have standard operational lives are the diversion structures, which would have a typical life of about 100 years.

Certain features of the Instream Structures Alternative such as cabled logs could have operational lives of as short as 3-5 years because of potential washouts by high flows. Other more permanent structures such as rock weirs and boulder placements could have operational lives of 10-20 years, depending on the rate of bed sediment transport and deposition in the channel under post-Jordanelle Dam conditions.

Table 1-15 shows the projected capital, property acquisition and maintenance costs of the Proposed Action and PRRP alternatives. The project's capital costs consist of design, construction and contingencies. Assumed costs for property acquisition were $15,000 per acre for fee title acquisition and $7,500 per acre for easement acquisition. Annual maintenance costs include inspections and maintenance of the project components. The PRRP has no annual operational costs.

1.11.7 Standard Operating Procedures

This section defines standard operating procedures (SOPs) for the PRRP. SOPs would be followed during construction and maintenance of the project to avoid or minimize adverse impacts to people and natural resources. The mitigation measures identified in Chapter 3 are designed to avoid or minimize the adverse and significant impacts of the project expected to occur after the SOPs have been successfully implemented.

The SOPs listed in Section 1.12.9 of Chapter 1 of the WCWEP and DRP EIS are pertinent to the PRRP as well, and are incorporated by reference. These SOPs cover the following resource topics:

- Agriculture
- Air Quality
- Aquatic Resources
- Cultural Resources
- Energy Conservation
- Health and Safety
- Noise
- Revegetation and Erosion Control
- Transportation
- Visual Resources
- Water Quality
- Wetlands
- Wildlife Resources

1.11.7.1 Standard Operating Procedures During Construction

The following SOPs would be used during construction of the PRRP, in addition to those listed in Section 1.12.9.1 of the WCWEP and DRP EIS.

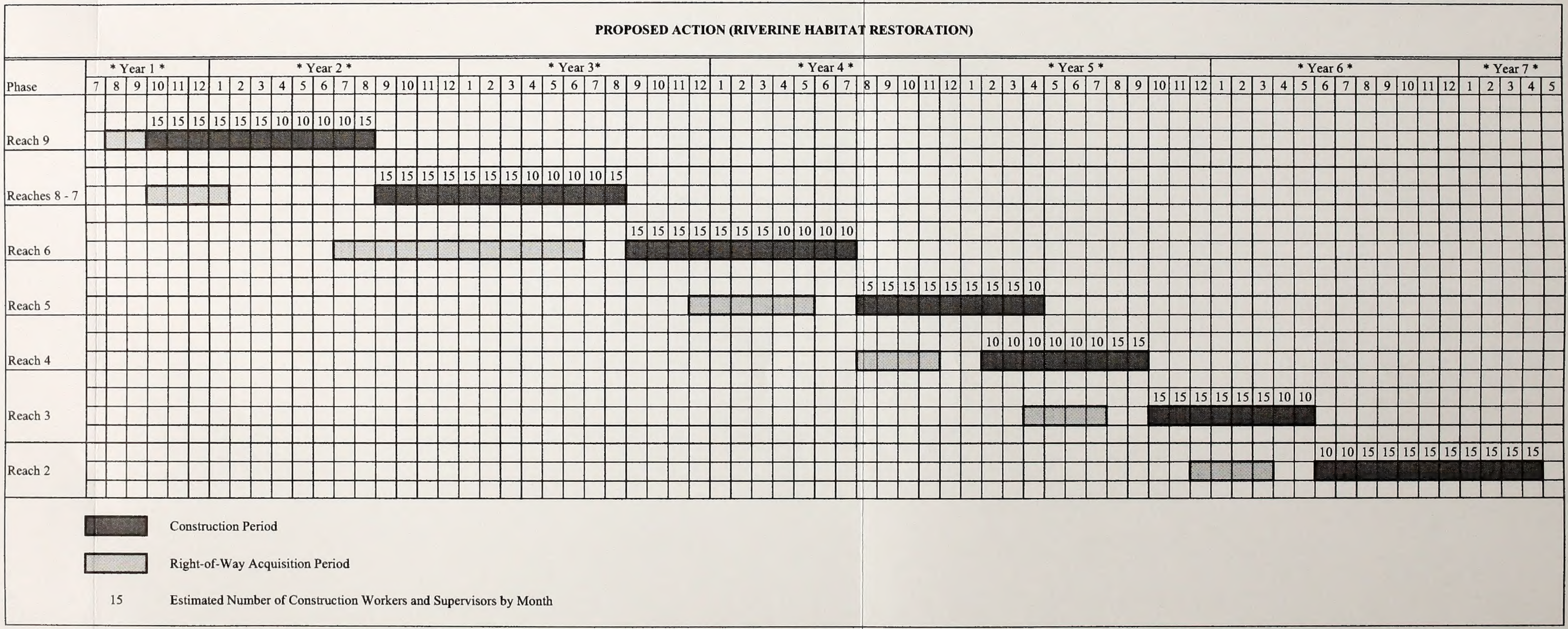


Figure 1-11
Construction Schedule and Average Number of workers for Proposed Action

EXISTING CHANNEL MODIFICATION ALTERNATIVE

	* Year 1 *						* Year 2 *												* Year 3*												* Year 4 *												* Year 5 *											
Phase	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
				15	15	15	15	15	15	10	10																																											
Reach 9		░	░	▨	▨	▨	▨	▨	▨	▨	▨																																											
												10	10	15	15	15																																						
Reach 8		░	░									▨	▨	▨	▨	▨																																						
																	15	15	15	15	15	10																																
Reach 7		░	░	░	░	░	░										▨	▨	▨	▨	▨	▨																																
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Reach 6		░	░	░	░	░	░															▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨																				
																															10	10	10	15	15																			
Reach 5		░	░	░	░	░	░																								▨	▨	▨	▨	▨																			
																																			5	5	5	15	15	15	15	15	10	10	10	10								
Reach 4		░	░	░	░	░	░																												▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨								
																																										10	10	10	10	10	10	10	10					
Reach 3		░	░	░	░	░	░																																			▨	▨	▨	▨	▨	▨	▨	▨					
																																																		15	15	15		
Reach 2		░	░	░	░	░	░																																											▨	▨	▨		

INSTREAM STRUCTURES ALTERNATIVE

	* Year 1 *						* Year 2 *											
Phase	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
		6	6	6	6	6												
All Reaches		▨	▨	▨	▨	▨												

▨	Construction Period
░	Right-of-Way Acquisition Period
15	Estimated Number of Construction Workers and Supervisors by Month

Figure 1-12
Construction Schedule and Average Number of Workers for Existing Channel Modification Alternative

Figure 1-13
Construction Schedule and Average Number of Workers for the Instream Structures Alternative

Table 1-12
Employment Opportunities and Estimated Pay Rates for Construction and Maintenance of the Proposed Action and PRRP Alternatives

Category	Compensation	Work-Months		
		Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Construction Contractor Forces				
Administrative	$55,000/yr	31	24	1.3
Supervisory	$45,000/yr	62	48	2.5
Skilled Labor	$22.96/hr	312	240	7.5
Unskilled Labor	$10.76/hr	374	288	13.0
Total Contractor Work Force[1]		779	600	24.3
Construction Management Staff				
Administrative	$50,000/yr	31	24	1.3
Professional	$65,000/yr	31	24	1.3
Technician/Inspector	$35,000/yr	62	48	2.5
Total Construction Management Work Force		124	96	5.1
Total Work-Months		**903**	**696**	**29.4**
Maintenance Staff				
District Engineer	$65,000/yr	0.25/yr	0.25/yr	.25/yr
Clerical	$25,000/yr	0.25/yr	0.25/yr	.25/yr
Field Supervisor	$45,000/yr	0.5/yr	0.5/yr	1/yr
Field O&M Laborers	$30,000/yr	0.5/yr	1/yr	2/yr
Annual O&M Work-Months		**1.5/yr**	**2/yr**	**3.5/yr**

Notes:

[1] Does not include offsite waste material haul manpower.

Table 1-13
Construction Transportation Requirements for the Proposed Action and PRRP Alternatives

	Construction Off-Site Traffic in Round Trips							
	Construction Management Staff		Contractor Worker Vehicles		Rock Truck Haul		Waste Truck Haul	
	Total	Peak Daily	Total	Peak Daily	Total	Peak Daily	Total	Peak Daily
Proposed Action (Riverine Habitat Restoration)	2,500	4	16,500	25	0	0	4,100	7
Existing Channel Modification Alternative	2,000	4	14,000	25	0	0	4,700	10
Instream Structures Alternative	150	2	750	10	26	1	0	0

Table 1-14
Construction Material Requirements for the Proposed Action and PRRP Alternatives

Page 1 of 2

Type of Material	Use of Material	Source of Material	Amount of Material		
			Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Timber	Logs for fish habitat structures	Source unknown	none	none	116
	Bridge reconstruction	Local source	2880 board-ft	none	none
Large Rock (>2 ft Dia.)	Fish habitat struct.	Local source	none	none	13,106 cu yd
	New channel riffles	On-site/Local source	13,300 cu yd	26,967 cu yd	none
	Special bank treatment	On-site/Local source	2,338 cu yd	1,360 cu yd	none
	Pool features	On-site/Local source	5,200 cu yd	5,300 cu yd	none
	Grade control struct.	On-site/Local source	2,184 cu yd	1,386 cu yd	none
	Rock drops	On-site/Local source	34,068 cu yd	37,241 cu yd	none
	Existing structure protection	On-site/Local source	1,336 cu yd	1,670 cu yd	none
		Total	**58,426 cu yd**	**73,924 cu yd**	**none**
Large River Cobbles	New channel riffles	On-site	43, 357 cu yd	75,644 cu yd	none
Pipe (8 in. diameter, concrete lined ductile iron)	**Jordanelle** Wetland water supply pipeline	Outside county; source unknown	400 ft		none
Concrete	Diversion structures	Local source	18 cu yd	20 cu yd	none
	Bridge relocations	Local source	489 cu yd	none	none
		Total	**507 cu yd**	**20 cu yd**	**none**
Steel	Diversion structures	Outside county; source unknown	1.6 tons	1.8 tons	none
	Bridge relocations	Outside county; source unknown	22.7 tons	none	none
		Total	**24.3 tons**	**1.8 tons**	**none**

Table 1-14
Construction Material Requirements for the Proposed Action and PRRP Alternatives

Page 2 of 2

Type of Material	Use of Material	Source of Material	Amount of Material		
			Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Fence (barbed wire)	Fence public access corridor	Source unknown	9,450 ft	4,570 ft	none
Vegetation (living and dead)	Bank stabilization (e.g., root wads, willow stakes)	On site	3.7 acres	3.1 acres	none
	Floodplain revegetation (e.g., sod mats, seeding)	On site/Local Source	96.0 acres	149.6 acres	none
		Total	**99.7 acres**	**152.7 acres**	**none**
Geotextile Fabric	Surface erosion management	Unknown	348,000 sq. yds.	543,000 sq. yds.	none
Waste Material		Spoil site: Heber Valley quarries	206,000 cu yd	237,000 cu yd	none

Notes:

1. For Proposed Action, approximately 48,000 cu. yds of rock are available from on-site salvage
2. For Existing Channel Modification Alternative, approximately 45,000 cu yd of rock are available from on-site salvage
3. Fence lengths are in addition to baseline fencing requirements (73,790 ft)

Table 1-15
Projected Costs of the Proposed Action and PRRP Alternatives
(1994 $)

	Estimated Capital Cost[1]	Estimated Right-of-Way Cost	Estimated Annual Maintenance Cost[2]
Proposed Action (Riverine Habitat Restoration)			
Reach 1	none	none	none
Reach 2	$1,596,000	$893,000	$700
Reach 3	$1,697,000	$698,000	$900
Reach 4	$1,913,000	$509,000	$800
Reach 5	$1,863,000	$547,000	$600
Reach 6	$3,669,000	$663,000	$1,100
Reach 7	$1,382,000	$338,000	$500
Reach 8	$1,338,000	$8,000	$700
Reach 9	$2,344,000	$0	$1,100
Total	**$15,802,000**	**$3,656,000**	**$6,400**
Existing Channel Modification			
Reach 1	none	none	none
Reach 2	$1,313,000	$353,000	$1,000
Reach 3	$2,093,000	$310,000	$1,300
Reach 4	$1,764,000	$358,000	$1,200
Reach 5	$1,497,000	$520,000	$800
Reach 6	$2,925,000	$527,000	$1,500
Reach 7	$1,487,000	$240,000	$800
Reach 8	$1,254,000	$0	$800
Reach 9	$2,263,000	$0	$1,500
Total	**$14,596,000**	**$2,308,000**	**$8,900**
Instream Structures	**$1,014,000**	**$2,241,000**	**$20,400**

Notes:

[1] Capital costs include construction, engineering and contingencies.

[2] Maintenance costs for Instream Structures Alternative assumed to be 3% of instream structure construction costs (per Aquatic Habitat Improvement Plan)

Aquatic Resources

The duration of heavy equipment intrusion into the existing channel will be minimized to the extent possible.

The procedures described in Section 1.7.3 will be applied to minimize sediment entrainment and turbidity resulting from disturbance of the existing channel. In addition, in-channel work will be minimized during high flow periods.

Revegetation and Erosion Control Procedures

Revegetation and erosion control SOPs will be used where project construction would disturb soil. These areas are expected to be along channel construction and modification areas, construction access roads, floodplain grading areas, setback dikes, and stockpile areas. The procedures will be designed to restore vegetation to pre-construction or native conditions, as appropriate, to prevent infestation by noxious plants and to avoid erosion and sedimentation problems.

Noxious weed control is an important component of the PRRP. Construction of the project would disturb a large number of acres, providing an opportunity for noxious weed invasion. Appendix A presents a Noxious Weed Control Plan.

If possible, Jordanelle Reservoir outflows would be managed during the 5 years following construction to prevent high flood flows that could cause erosion problems. This would allow riparian and floodplain vegetation to become established until it could provide erosion control. This procedure would be dependent on hydrologic conditions during and after project construction. If reservoir inflows are above normal, it may not be possible to manage outflows as desired.

Wetlands Procedures

Direct and indirect impacts on wetlands will be avoided to the extent practical. Procedures to avoid impacts will include protection of wetlands with silt fencing during construction and avoiding quantity and quality impacts on surface water and groundwater resources that serve as a source of water for wetlands.

If necessary, areas of proposed dike removal and breaching will be modified in the field during construction to protect and preserve as much riparian vegetation and wetlands along the existing river corridor as possible. Areas of heavy construction activity, equipment storage and stockpiling will be selected to minimize impacts on existing riparian vegetation and wetlands.

Wildlife Resources

To the extent feasible, the new channel alignment, setback dikes, and maintenance roads will be located and constructed to avoid or minimize the removal of large trees.

1.11.7.2 Standard Operating Procedures During Maintenance

SOPs to be applied during performance of maintenance activities are the same as described in Section 1.12.9.2 of the WCWEP and DRP EIS.

Provo River Restoration Project

Draft Environmental Impact Statement

Chapter 2
Comparative Analysis of Impacts of the Proposed Action and Alternatives

Chapter 2

Comparative Analysis of Impacts of the Proposed Action and Alternatives

2.1 Introduction

This chapter presents in summary fashion the impacts of the Proposed Action (River Habitat Restoration), Existing Channel Modification Alternative, Instream Structures Alternative, and the No Action Alternative. Detailed impact analysis is located in Chapter 3 and the seven draft technical reports listed at the beginning of Chapter 3. The impacts shown in this chapter are the impacts that would occur to baseline conditions. Information on baseline conditions is presented in Chapter 3, Section 3.1.2.

2.2 The No Action Alternative

The No Action Alternative would result in a continuation of baseline conditions. The No Action Alternative would result in the following impacts.

- The need to restore the Provo River to a more naturally-functioning, riverine ecosystem would not be met. The measures authorized by the Central Utah Project Completion Act (CUPCA) to rehabilitate riparian habitat and restore fish habitat in this reach of the Provo River would not be implemented.

The following commitments included in the M&I System EISs related to Jordanelle Reservoir (USBR 1979 and USBR 1987) would still be implemented under baseline conditions and their related effects would continue under the No Action Alternative.

- CUWCD would maintain a minimum streamflow of 125 cfs in the Provo River between Jordanelle and Deer Creek reservoirs

- Any existing river diversion facilities located between Jordanelle and Deer Creek reservoirs that are incapable of allowing a minimum of 125 cfs to pass at all times would be reconstructed to function properly under baseline. Any changes to river diversion facilities beyond those that would be made under baseline are described as part of the Proposed Action and alternatives.

- The Mitigation Commission would construct seven new fishing access points along the Provo River between Jordanelle and Deer Creek reservoirs, acquire and fence land along the Provo River to provide contiguous fishing access (by foot only), and construct parking areas and sanitary facilities

- CUWCD would deliver supplemental CUP water to water users in Heber Valley and below Deer Creek Reservoir as Jordanelle Reservoir goes into operation

The impacts of the commitments listed above were documented in the M&I System EISs related to Jordanelle Reservoir (USBR 1979 and USBR 1987).

- The need to comply with legal requirements defined in the documents cited in Section 1.2 of Chapter 1 would not be met. The required environmental improvements would have to be implemented elsewhere and are for partial mitigation of impacts caused by the Central Utah Project (CUP) and other USBR projects in Utah.

- The beneficial and adverse impacts summarized in Section 2.3 would not occur

2.3 Comparison of Impacts

Table 2-1 documents the quantified impacts of the Proposed Action and each alternative (with the exception of the No Action Alternative). Sections 2.3.1 through 2.3.17 discuss the impacts in Table 2-1 and those that where not quantifiable.

2.3.1 Water Resources

The Proposed Action would cause minor impacts on groundwater levels along the Provo River in Heber Valley. The Existing Channel Modification and Instream Structures alternatives would not cause any impacts on groundwater levels.

Table 2-1
Summary of Impacts of Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative

Page 1 of 3

Resource Topics	Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Water Resources • Change in Heber Valley Groundwater Levels (feet)	+1 to +3 along Provo River in northern portion of Heber Valley -1 along Provo River in south-central portion of Heber Valley	0	0
Water Quality • Change in Temperature During Summer Until New Vegetation is Established (degrees Fahrenheit)	from +1.2 in Reach 5 (+2%) to +6.2 in Reach 8 (+11%)	from 0 in Reach 4 to +5.4 in Reach 8 (+10%)	0
Wetlands • Net Change in Wetland Acres	+218.3	+78.8	+0
Aquatic Resources • Change in Pounds of Trout in Provo River	+25,754 (+491%)	+7,906.6 (+151%)	+3,077.4 (+59%)
Wildlife Resources • Net Change in Acres Wildlife Habitat	+218.3	+78.8	+0
Air Quality • Max. Vehicle Emissions During Any 12-Month Period of Construction (tons)	Nitrogen oxides: 80 Sulfur oxides: 17 Particulates: 5	Nitrogen oxides: 78 Sulfur oxides: 7 Particulates: 6	Nitrogen oxides: 23 Sulfur oxides: 2 Particulates: 2

Table 2-1
Summary of Impacts of Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative

Page 2 of 3

Resource Topics	Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Agriculture			
• Production Loss During Construction (AUM* of grazing/pasture)	-1,266	-54	-5
• Annual Loss of Production After Construction	-1,203	-49	0
Socioeconomics			
• Change in Gross Agricultural Revenue During Construction (total $)	-$8,862	-$378	-$32
• Change in Total Gross Revenue in Wasatch County During Construction (peak annual $)	+$84,000 (<1%)	+$77,000 (<1%)	+$4,000 (<1%)
• Change in Total Income in Wasatch County During Construction (peak annual $)	+$561,000 (+<1%)	+$587,000 (+<1%)	+$89,000 (+<1%)
• Change in Total Gross Revenue in Wasatch County After Construction ($ per/yr)	+$79,000 (+<1%)	+$26,000 (+<1%)	+$8,000 (+<1%)
Recreation			
• Change in Recreation Use Along Provo River (angler days/yr)	+9,240 (+662%)	+2,836 (+251%)	+1,104 (+159%)

Table 2-1
Comparison of Impacts of Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative

Page 3 of 3

Resource Topics	Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Transportation • Peak Increase in Traffic During Construction (daily trips)	39 on Hwy. 189 (+1%) 78 on Hwy. 40 (+1%) 78 on River Road (+6%) 78 on Hwy. 113 (+2%)	42 on Hwy. 189 (+1%) 78 on Hwy. 40 (+1%) 78 on River Road (+6%) 78 on Hwy. 113 (+2%)	12 on Hwy. 189 (<1%) 26 on Hwy. 40 (<1%) 26 on River Road (+2%) 26 on Hwy. 113 (+1%)

Note:

Impacts in this table are defined by comparing conditions with the Proposed Action and alternatives to baseline conditions (the same way impacts are defined in Chapter 3). Percent change is the change from baseline conditions.

TSS = Total Suspended Solids; NO_3 - Nitrates; and TP - Total Phosphorus

*AUM is animal unit month, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

2.3.2 Water Quality

The Proposed Action and Existing Channel Modification Alternative would cause minor increases in Provo River temperatures until new vegetation is established. The acquisition and fencing of land in addition to the area included in baseline under the Proposed Action would decrease Total Phosphorus (TP) and Total Suspended Solids (TSS) loads in the Provo River and Deer Creek Reservoir after construction. The Existing Channel Modification and Instream Structures alternatives would not decrease TP and TSS loads. Construction of the Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would cause temporary and minor increases in TSS and TP concentrations in the Provo River and Deer Creek Reservoir.

2.3.3 Wetlands

The Proposed Action would have short-term adverse impacts on 24.7 acres of wetlands during construction, 74.2 acres of wetlands would be permanently removed and 292.5 acres would be created, over 3 to 30 years while construction of the Existing Channel Modification Alternative would cause short-term adverse impacts on 116.8 acres of wetlands during construction, direct wetland impacts that include removal of 63.1 acres of wetland vegetation and about 141.9 acres of riparian habitat would be created over 3 to 30 years in the new floodplain. The Proposed Action causes impacts to the 26.1 acres of USBR wetlands while the Existing Channel Modification Alternative does not impact these areas. The Instream Structures Alternative would cause only insignificant disturbances to riparian vegetation during construction and not cause any other impacts on wetlands.

2.3.4 Aquatic Resources

The Proposed Action and alternatives (with the exception of the No Action Alternative) would enhance aquatics resources habitat and trout populations over baseline conditions (see Table 2–1). The side channels associated with the Proposed Action would benefit both game and non–game species, including the leatherside chub (a State of Utah species of special concern).

2.3.5 Wildlife Resources

The Proposed Action and Existing Channel Modification Alternative would cause net increases in wildlife habitat equal to the increase in wetlands described in Section 2.3.3 and defined in Table 2-1. Many cottonwood trees would be removed during construction of the Proposed Action and Existing Channel Modification Alternative, but not during construction of the Instream Structures Alternative. New cottonwoods would be planted, which would take about 15 to 30 years to reach a height and size comparable to those removed.

2.3.6 Threatened and Endangered Species

The Proposed Action and Existing Channel Modification Alternative have potential to cause adverse and significant impacts on threatened and endangered (T&E) species habitat, but all temporary impacts caused by construction would be fully mitigated. Under the Proposed Action, T&E species habitat would increase over the long-term. The direct loss or degradation of Ute ladies'-tresses, bald eagle, peregrine falcon and spotted frog habitat would occur during construction of the Proposed Action and Existing Channel Modification Alternative. The Existing Channel Modification Alternative would permanently remove spotted frog habitat. The taking of spotted frogs could occur under the Proposed Action and Existing Channel Modification Alternative, but conservation measures are proposed to avoid and minimize impacts on this species as well as Ute ladies'-tresses. The increase in trout populations caused by the Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would benefit bald eagles.

2.3.7 Soil Resources

The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would cause minor increases in soil erosion during and immediately after construction.

2.3.8 Mineral and Energy Resources

The Proposed Action and alternatives (except No Action) would affect Heber Valley mineral resource sites by depositing earth material in gravel pits. They would also require the use of energy during their construction.

2.3.9 Air Quality

The Proposed Action and alternatives (Except No Action) would cause an increase in vehicle emissions over baseline during the construction period. However, none of the actions would result in a violation of applicable air quality standards. The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would cause slight increases in vehicle emissions after construction as recreation traffic increases.

2.3.10 Agriculture

The Proposed Action and Existing Channel Modification Alternative would both cause temporary and permanent impacts on agricultural land along the Provo River. The Instream Structures Alternative would cause a very small reduction in production during construction and no impacts after construction.

2.3.11 Socioeconomics

Construction of the Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would increase gross revenue, income and employment in the construction and retail trade sectors of the local economy. The total increase in revenue would be considerably larger than the decrease in agricultural revenue. After construction, the Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would increase revenue and income for businesses that serve recreationists.

2.3.12 Health and Safety

The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would cause a minor increase in potential health and safety hazards for construction workers and other drivers because of a slight increase in the risk of traffic accidents. The risk of traffic accidents also would increase after construction as recreation-related traffic increases.

2.3.13 Noise

The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would cause adverse noise impacts during construction and from recreation traffic after construction. Some noise impacts during construction would be significant for people who walk, drive or reside within 50 feet of construction.

2.3.14 Visual Resources

The Proposed Action and Existing Channel Modification alternative would impact visual resources during construction as a large number of mature trees and other riparian vegetation is removed. However, they would improve the visual character of the Provo River corridor in the long–term. The Instream Structures Alternative would not impact visual resources except during construction.

2.3.15 Recreation Resources

The increase in trout populations and other improvements to the Provo River ecosystem would increase recreation use in the corridor over the long-term. The increase in recreation use would be in proportion to the increases in trout populations (see Table 2–1).

2.3.16 Cultural Resources

The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would not impact any known cultural resource sites, but have the potential to do so. The extent and location of potential impacts would not be known until complete inventories are conducted before construction.

2.3.17 Transportation

The Proposed Action, Existing Channel Modification Alternative and Instream Structures Alternative would increase traffic on local roads during construction (see Table 2-1).

Provo River Restoration Project

Draft Environmental Impact Statement

Chapter 3
Affected Environment and Environmental Consequences

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

The purposes of this chapter are to describe the affected environment (baseline conditions) of resources of the human environment that would be impacted by the Proposed Action and alternatives, and to document the environmental consequences (direct, indirect and cumulative impacts) on the quality of the human environment.

This chapter is organized by resource topic. Each resource topic lists the issues addressed in the impact analysis, describes the specific impact area of influence, identifies baseline conditions, establishes significance criteria and documents impacts under the Proposed Action (Riverine Habitat Restoration), Existing Channel Modification Alternative, Instream Structures Alternative and the No Action Alternative. The assumptions and methodology used to analyze impacts for each resource topic are presented in Appendix B, Section B.3. The last four sections of this chapter describe measures that would be used to mitigate significant impacts, unavoidable adverse impacts, net cumulative impacts and irreversible and irretrievable commitment of resources for resource topics.

The impact analysis focuses on issues raised in the public scoping process and on documenting environmental impacts at a level of detail matching the intensity, duration and magnitude of impact. Significant impacts on resources are discussed in detail, and resource impacts that are not significant are summarized. The impact analysis incorporates the Standard Operating Procedures (SOPs), described in Section 1.1 of Chapter 1 in the Provo River Restoration Project (PRRP) EIS, which would be implemented during construction and operation to protect environmental resources.

The impact analysis presented in this chapter is supported by seven draft technical reports prepared for specific resources, which provide detailed technical information on baseline conditions, analysis methods used to determine impacts, and results of the impact analyses. The following draft technical reports are summarized in resource sections of this chapter:

- Water Resources
- Water Quality
- Wetlands
- Aquatic Resources
- Wildlife Resources
- Threatened and Endangered Species
- Cultural Resources

These technical reports are not intended as "stand-alone" documents; they rely on information about the Proposed Action and alternatives that is described in Chapter 1 of the PRRP EIS. The technical reports are available from the Central Utah Water Conservancy District (CUWCD) upon request at the following address:

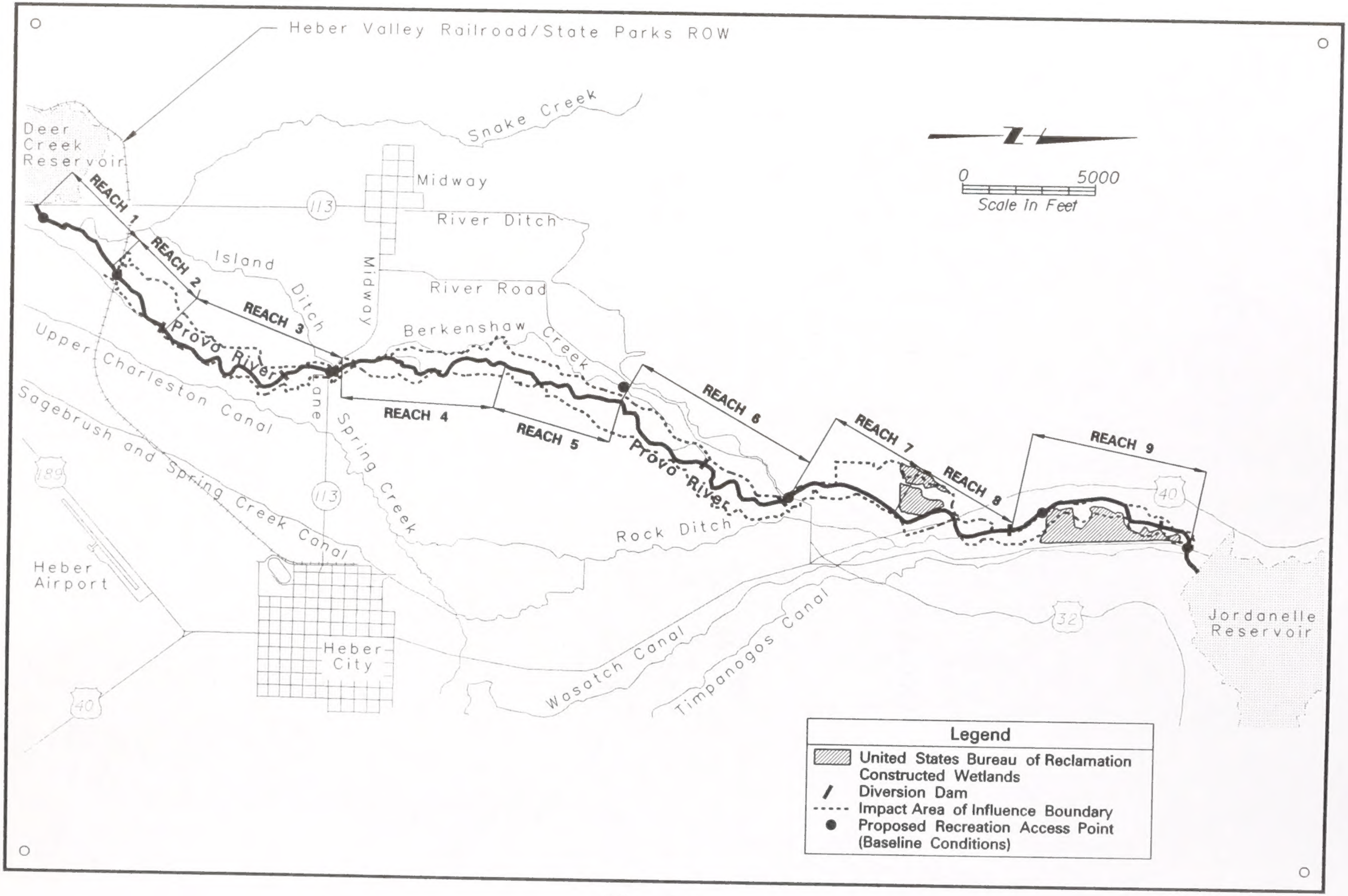
Karen Ricks, Project Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058-7303

3.1.1 General Information

This section provides general information about the overall impact area of influence and environmental resources eliminated from detailed documentation of impacts.

3.1.1.1 Direct Impact Area of Influence

The direct impact area of influence is shown on Map 3-1. It covers nine reaches of the Provo River between Jordanelle Dam and Deer Creek Reservoir. These reaches represent distinctly different river segments into which the Provo River was divided for planning and environmental analysis purposes. The direct impact area of influence ranges from about 200 to 2,200 feet wide along the nine reaches. This is where most of the impacts on environmental resources would occur under the Proposed Action and alternatives. Additional indirect impacts would occur over a broader area, such as socioeconomic impacts in the rest of Wasatch County. Descriptions of impacts under the Proposed Action and alternatives make frequent reference to the river reaches shown on Map 3-1.



Map 3–1
Direct Impact Area of Influence

3.1.1.2 Environmental Resources Eliminated

The impact analysis conducted for this Environmental Impact Statement (EIS) considered all resources of the human environment subject to requirements specified in statutes, regulations or executive orders. Resources not present or not affected by the Proposed Action or alternatives may be eliminated from detailed documentation of impacts. The resources eliminated from detailed documentation are the same as listed in Section 3.1.1.2 of Chapter 3 in the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) EIS.

3.1.2 Existing Conditions Versus Baseline

This section provides a broad overview of the baseline environmental conditions analyzed in this DEIS, and points out the differences between the baseline and the existing conditions in the impact area of influence. The baseline, also referred to as the affected environment, is the set of environmental conditions expected to occur regardless if the Proposed Action or its alternatives are implemented. It is important to establish the baseline to understand the potential impacts of the Proposed Action and each alternative.

The baseline for the PRRP is not the same as existing conditions. Existing conditions are constantly changing because of factors beyond the control of this project. However, this document considers those changes that are expected to occur by the year 2000 as part of the baseline, if they are federal CUP-related commitments or requirements. These commitments include requirements of the Final Supplement to the Final Environmental Statement for the M&I System (USBR 1987) for providing seven new recreation access points (including parking areas and sanitary facilities); providing fishing access (by foot only) through land acquisition along the entire Provo River corridor between Jordanelle Dam and the inlet to Deer Creek Reservoir; fencing of the public access corridor; and maintaining a minimum instream flow of 125 cfs in the same reach of the Provo River. Modifications to some existing diversions in the Provo River will be required to pass the 125 cfs minimum instream flow. The width of the public access corridor would basically be the area between the outside edge of the existing dikes, or an area extending about 50 feet beyond the existing channel banks in undiked sections of the river. These commitments will be implemented regardless of a decision to implement the PRRP described in this EIS. The impacts of the previous commitments defined above, which become part of the baseline for this DEIS, were documented in the previously referenced EIS. Therefore, those impacts are not included in the analysis of the Proposed Action or its alternatives.

Table 3-1 provides an overview of existing and baseline conditions. These data are provided to help the reader understand the differences between existing and baseline conditions and are based on the direct impact area of influence described in Section 3.1.1.1. There were no predicted or identifiable changes between existing and projected baseline conditions for the following resources: wetlands, wildlife, threatened and endangered species, soils, mineral and energy, air quality, health and safety, noise, visual resources, cultural and paleontological resources. Each resource topic section in this chapter provides a brief description of the baseline conditions that were used in determining impacts of the Proposed Action and each alternative.

3.2 Water Resources

3.2.1 Introduction

This analysis addresses potential impacts on water resources from the construction and maintenance of the Proposed Action and alternatives. The information and analysis documented in this section was summarized from the Draft Water Resources Technical Report (CUWCD 1996c), which is available from CUWCD upon request. This section focuses on the potential surface and subsurface hydrologic impacts of the PRRP. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.1.

Table 3-1
Existing and Baseline Conditions for Major Environmental Resources

Resource Topic and Sub-Topic	Existing Condition	Projected Baseline Condition
Water Resources		
Minimum Provo River flow below Timpanogos Diversion (cfs)	23.00	125.00
Minimum Provo River flow below Midway Diversion (cfs)	0.00	125.00
Water Quality		
Late summer average water temperature in Reach 2 (^{0}F)	55.70	55.70
Total phosphorus (TP) average concentration discharged from Provo River to Deer Creek Reservoir (mg/L)	0.07	0.04
Total suspended solids (TSS) average concentration discharged from Provo River to Deer Creek Reservoir (mg/L)	33.10	10.90
Nitrate (NO_3) average concentration discharged from Provo River to Deer Creek Reservoir (mg/L)	0.48	0.17
Aquatic Resources		
Weighted average predicted trout standing crop (lb/acre)	28.50	57.20
Total trout biomass (pounds)	2,554.00	5,246.00
Agriculture Resources		
Grazing land (acres)	33.50	33.50
Cropland (irrigated pasture) (acres)[1]	376.30	361.40
Total animal unit months (AUM) produced	2,503.00	2,406.00
Socioeconomic Resources[2]		
Agricultural gross revenue	$17,524.00	$16,846.00
Retail Trade gross revenue	$70,435,000.00	$70,453,000.00
Total Wasatch County Revenue	$120,656,000.00	$120,673,000.00
Recreation Resources		
Angler days	916.00	1,882.00
Transportation Resources		
Highway 40 annual average daily traffic (AADT)	9,498.0	10,550.00

Notes:

[1] To achieve baseline conditions, a total of 180.7 acres of private land would be acquired, which includes the 14.9 acre difference in cropland.

[2] The socioeconomic data is based on Wasatch County.

The following surface water topics are addressed in the impact analysis:

- Changes in the availability of water supplies to water users
- Changes in streamflow
- Changes in reservoir storage, surface area and water surface elevation

The following groundwater topics are addressed in the impact analysis:

- Changes in recharge and discharge to the Heber Valley groundwater basin
- Changes in groundwater basin water levels and storage volumes

The Proposed Action and alternatives would not change the long-term pattern or frequency of flow releases from Jordanelle Reservoir. If there is a possibility of reservoir spillage, peak flows may be reduced by pre-releasing water from Jordanelle Reservoir storage during high inflow periods before workers begin modifying the river channel. All water supply and minimum instream flow requirements would be met. The potential of the Proposed Action and alternatives to change the risk of flooding resulting from physical alteration of the river channel is addressed in the Health and Safety (Section 3.13).

3.2.2 Issues Eliminated From Further Analysis

The following water resource issues identified through the public scoping process were eliminated from further analysis:

- How would diversion rights (capacity and quantity) from the Provo River be impacted by channel alterations?

  All water supply facilities removed or modified by the PRRP to change river channel geometry, alignment or grade would be reconstructed to provide diversion capability at least equal to the facilities that are removed or modified. In cases where the channel elevation is lowered, new diversion facilities would be constructed upstream and connected to existing canals at a proper grade to provide the same diversion capability that presently exists. These measures would result in no changes in diversion timing or quantity from the Provo River.

- What opportunities would the PRRP provide for diverting Provo River flows into Berkenshaw Creek to supplement instream flows?

  Only the Proposed Action includes restoration of areas outside the existing channel easements, where Berkenshaw Creek is located, and enhancement of or creation of side channels along the river corridor. During development of the Proposed Action, it was determined that the greatest aquatic benefits would be realized with a single new side channel along the east side of the Provo River in the vicinity of Berkenshaw Creek and by maintaining existing Berkenshaw Creek conditions. Therefore, the Proposed Action as defined in Chapter 1 does not include any physical or hydrologic changes to Berkenshaw Creek.

- How would irrigation water be provided to farms divided by the new channel alignments of the Proposed Action?

  The Proposed Action includes acquisition of additional land for the Provo River corridor, beyond the amount acquired under baseline conditions. Farms straddling the present river channel that would be severed by the acquisition and realignment of the river corridor presently have separate water diversion and conveyance facilities on each side of the river. These facilities would remain or be relocated and reconstructed to a level that assures the same water reliability as baseline conditions. Therefore, the additional land acquisition and realigned river channel would not impact water availability to the severed parcels, but would impact the size of the remaining parcels (see Section 3.11 for related potential impacts on agricultural operations). Payment to construct livestock watering facilities outside the acquired corridor would be included in the rights-of-way acquisition process where warranted.

3.2.3 Issues Addressed in the Impact Analysis

3.2.3.1 Surface Water Issues

The following surface water issues were raised during scoping and are addressed in the impact analysis:

- What impacts would the PRRP have on diversion rights from the Provo River?
- What impacts would the PRRP have on private diversions from the river?
- What impacts would the PRRP have on existing irrigation diversion facilities on the river and who would be responsible for their maintenance?
- What impacts would the PRRP have on reducing peak flow rates from Jordanelle Reservoir during the summer months?

3.2.3.2 Groundwater Issues

The following groundwater issues were raised during scoping and are addressed in the impact analysis:

- How would the PRRP affect wells and flows from springs?
- What impacts would occur to groundwater levels?

3.2.4 Description of Impact Area of Influence

The Water Resources impact area of influence is the same as that described in Section 3.1.1.1.

3.2.5 Affected Environment (Baseline Conditions)

The baseline conditions that would occur in the future under full demand development would be the same as those described for the Provo River area in Section 3.2.5 of Chapter 3 in the WCWEP and DRP EIS. Provo River flows and groundwater resources in the impact area of influence of the PRRP are described in subsections 3.2.5.5 and 3.2.5.7, respectively.

3.2.6 Impact Analysis

3.2.6.1 Significance Criteria

The significance criteria used for the PRRP analysis are the same as described in Section 3.2.6.1 of the WCWEP and DRP EIS.

3.2.6.2 Potential Impacts Eliminated From Further Analysis

None of the water resources potential impacts raised during the scoping and listed in Section 3.2.4 were eliminated from further analysis.

3.2.6.3 Proposed Action (Riverine Habitat Restoration)

The following subsections describe potential water resource impacts from construction and operation of the Proposed Action.

3.2.6.3.1 Surface Water Impacts. Under the Proposed Action, realignment of the Provo River would lengthen the channel from 10.3 miles to about 12.3 miles. The change in channel slope and cross-section geometry would reduce average flow velocity. Time of travel of the flow from Jordanelle to Deer Creek reservoirs would increase from 3.9 hours to 4.9 hours at a flow rate of 500 cfs. This is the typical flow rate when releases of Central Utah Project (CUP) M&I water from Jordanelle Reservoir would be made to users below Deer Creek Reservoir. Since releases from Jordanelle Reservoir would generally not change abruptly from day to day, the increased time of travel would not change the release pattern from Jordanelle to Deer Creek reservoirs.

3.2.6.3.2 Groundwater Impacts. Changes in river grade and alignment under the Proposed Action would impact infiltration and discharge of water along the Provo River channel. There would be no overall loss or gain of surface water to groundwater. However, in the northern part of the valley along the Provo River, river seepage could increase as the surface area of the stream bed increases, slightly raising groundwater levels 1-3 feet in the northern most mile of the river. This additional seepage could occur where the stream bed is in a "losing" reach of the river (i.e., the stream bed is higher than groundwater and river water is seeping into the ground under baseline conditions).

The river in this area is incised because of erosion and downcutting of the river channel invert. Under the Proposed Action, the channel invert would be raised and the flow of the river would not be confined within existing dikes. Groundwater levels are shallow in the area and would likely adjust to match the grade of the river. Groundwater levels would depend on the final design grade of the river. Groundwater levels would not change if the final grade is similar to the present channel elevation.

Conversely, groundwater is discharging to the river in the south-central part of the valley, 1-2 miles upriver from Deer Creek Reservoir along the Provo River. In this "gaining" reach of the river (where the stream bed is lower than surrounding groundwater), groundwater discharge could increase and groundwater levels would likely be lower than under baseline conditions by up to 1 foot.

Groundwater recharge in the areas of Heber Valley not adjacent to the Provo River would be the same as under baseline conditions. Groundwater discharge would be impacted by changes in the grade of the river channel in areas where the groundwater table is directly related to the stage (depth of flow) of the river. The average groundwater discharge impacts in Heber Valley along the Provo River under the Proposed Action are less than one-tenth of 1 percent greater than baseline, as shown in Table 3-2.

Table 3-2
Modeled Groundwater Recharge and Discharge Impacts
Under the Proposed Action (Riverine Habitat Restoration)
(Average Conditions*)

Category	Baseline (ac-ft)	Recharge/ Discharge (ac-ft)	Change from Baseline (ac-ft)	Change from Baseline (%)
Groundwater Basin Recharge				
Unconsumed Agriculture Water and Precipitation	89,749	89,749	0	0.0%
Supplemental Instream Losses	0	0	0	0.0%
Daniels Creek Channel Losses	1,838	1,838	0	0.0%
Total Groundwater Recharge	**91,587**	**91,587**	**0**	**0.0%**
Groundwater Basin Discharge				
Local Drains and Seeps	26,915	26,595	(320)	-1.2%
Evapotranspiration	8,053	7,926	(127)	-1.6%
Snake Creek Accretions	7,512	7,502	(10)	-0.1%
Provo River Accretions	25,351	25,884	533	2.1%
Deer Creek Reservoir Accretions	23,917	23,839	(78)	-0.3%
Total Groundwater Discharge	**91,748**	**91,746**	**(2)**	**0.0%**
Groundwater Basin Change In Storage	**(161)**	**(159)**	**2**	**1.2%**

Note:

*Average conditions are the average hydrologic conditions over a 40-year period.
( ) Parenthesis denotes a negative value.

During a dry year, there would be a small decrease in groundwater basin discharge (approximately 40 acre-feet). The dry year decrease in discharge would be offset by a comparable increase in discharge during wet years, resulting in no net loss or gain over an extended period. The increased loss of 40 acre-feet during a dry year represents less than 0.02 percent of the total flow of the river, which is far less than the accuracy of methods used to measure water flow.

The changes in groundwater levels, storage and discharge summarized above would not impact wells and springs in Heber Valley.

3.2.6.3.3 Impact Summary. Surface water travel time would have an average increase of about 1 hour for flows from Jordanelle to Deer Creek reservoirs because of the longer channel and slower flow velocities. During a dry year, the increased length of river channel would cause an estimated increase of 40 acre-feet in net river channel seepage to groundwater. The greatest changes in groundwater levels would be an increase of about 1-3 feet in the northern portion of the valley adjacent to the river. These groundwater level increases would be associated with changes in the grade and length of the river channel, which affects the surface area and seepage interaction between the river and groundwater basin.

3.2.6.4 Existing Channel Modification Alternative

The following subsections describe potential water resource impacts from construction and operation of the Existing Channel Modification Alternative.

3.2.6.4.1 Surface Water Impacts. Under the Existing Channel Modification Alternative, a series of step-pool reaches would be constructed in the existing river corridor, which would slow the velocity of flow in the pool reaches. Time of travel of the flow from Jordanelle to Deer Creek reservoirs would increase from 3.9 hours to 4.1 hours at a flow rate of 500 cfs.

3.2.6.4.2 Groundwater Impacts. No impacts on groundwater levels, return flows or wells and springs would occur under the Existing Channel Modification Alternative.

3.2.6.4.3 Impact Summary. Surface water impacts would be limited to an average increase of about 12 minutes in the time of travel of flows from Jordanelle to Deer Creek reservoirs. No quantifiable changes in groundwater levels, recharge or discharge would occur.

3.2.6.5 Instream Structures Alternative

The surface water and groundwater impacts of this alternative would be nearly identical to the impacts of the Existing Channel Modification Alternative described in Section 3.2.6.4. This alternative would not cause any adverse water resource impacts.

3.2.6.6 No Action Alternative

The No Action Alternative would have no impacts on water resources. The baseline water resource conditions described in Section 3.2.5 would continue under the No Action Alternative.

3.3 Water Quality

3.3.1 Introduction

This analysis addresses potential impacts on water quality from the construction and maintenance of the PRRP. The information and analysis documented in this section was summarized from the Draft Water Quality Technical Report (CUWCD 1996e), which is available from CUWCD upon request. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.2. This section focuses on the primary types of water quality impacts that could occur from surface water and groundwater changes caused by the Proposed Action and alternatives.

The following water quality topics are addressed in the impact analysis:

- Water quality in the Provo River
- Water quality in Deer Creek Reservoir

3.3.2 Issues Eliminated From Further Analysis

The following issue was eliminated from further analysis.

- Groundwater Quality

The PRRP groundwater analysis concluded the Proposed Action would cause minor changes to groundwater levels in two isolated areas along the river channel. These changes are too minor to cause groundwater quality impacts. Other PRRP alternatives would not cause any groundwater changes. Therefore, groundwater quality is not an issue.

3.3.3 Issues Addressed in the Impact Analysis

The following surface water quality issues were identified during scoping and are addressed in the impact analysis:

- What impacts would occur to water quality from repeated maintenance that could be required with the Proposed Action?
- What impacts would the PRRP have on existing septic tanks located near the Provo River, and how would water quality be affected? How close to the river could septic tanks be safely located without affecting water quality?
- How would construction of the Proposed Action affect water quality?
- How would the Proposed Action affect water quality and sediment in Deer Creek Reservoir?
- What water quality impacts would occur from increased human waste due to recreational use?

3.3.4 Description of Impact Area of Influence

The PRRP water quality impact area of influence is the Provo River between Jordanelle and Deer Creek reservoirs and Deer Creek Reservoir as shown on Map 3-1 in Section 3.1.1.1.

3.3.5 Affected Environment (Baseline Conditions)

This section defines the water quality environment that would be affected by the Proposed Action and alternatives for the Provo River and for Deer Creek Reservoir. The affected environment is also referred to as baseline conditions.

3.3.5.1 Provo River

3.3.5.1.1 Nutrients and Sediment. Subsection 3.3.5 of the WCWEP and DRP EIS describes existing and baseline concentrations of nutrients and sediments in the Provo River. One additional change under the PRRP baseline would be the acquisition and fencing of about 14.9 acres of agricultural land. Fencing would exclude livestock and reduce TP loads in the river by about 22 kg/yr (48 lbs/yr). This reduction is less than 0.2 percent of the annual TP load in the river and would not affect baseline concentrations.

3.3.5.1.2 Temperature. Table 3-3 shows the equilibrium water temperatures for the Provo River above Deer Creek Reservoir in late summer under baseline conditions, along with the percentage of each reach that has riparian vegetation. These temperatures were estimated from summer-monitored temperature in Reach 2 when flows in the river were similar to late-summer (August) flows predicted by the water resources analysis, so the analysis incorporates the effects of the 125 cfs minimum flow.

3.3.5.2 Deer Creek Reservoir

3.3.5.2.1 Sediment. Section 3.3.5 of the WCWEP and DRP EIS describes baseline total suspended solid (TSS) loads to Deer Creek Reservoir from the Provo River.

3.3.5.2.2 Eutrophication. Excess TP in reservoirs and other waters is a primary factor that can lead to eutrophication. The estimated average annual TP concentration in Deer Creek Reservoir using the phosphorus sedimentation model for average hydrologic and baseline conditions is 0.031 mg/L.

Table 3-3

Baseline Temperatures by Reach in the Provo River

Reach*	Percent of Reach with Riparian Shading	Temperature °F
2	66	**55.7**
3	86	**53.1**
4	64	**56.0**
5	40	**59.1**
6	77	**54.8**
7	92	**52.3**
8	75	**54.5**
9	85	**53.2**

Note:

*Reach 1 was not assessed because riparian vegetation in this reach would not be cleared under the Proposed Action and alternatives.

3.3.5.2.3 Temperature and Mixing Status. Under existing conditions Deer Creek Reservoir is dimictic (i.e., the reservoir mixes vertically once in the spring and once in fall). Vertical mixing during mid- to late summer is prevented by thermal stratification. Stratification begins in June, is pronounced through July and August, then lessens in September. The entire water column starts to reach similar temperatures before turnover in late September or early October (Woodward-Clyde 1995, EWPE 1994).

The PROSIM model, described in Section 3.2 and Appendix B.2.1, modeled average Deer Creek Reservoir surface elevation for baseline conditions at 5,397 feet. The minimum elevations modeled for July and August over the 30-year record modeled, are 5,338 and 5,330 feet, respectively. The baseline average depth is 117 feet, and minimum depths are 58 feet for July and 50 feet for August. All of these elevations are sufficient to maintain maximum water depths greater than the 33 feet found by Heiskary and Wilson (1990) as the depth necessary to maintain temperature stratification.

3.3.6 Impact Analysis

3.3.6.1 Significance Criteria

The following significance criteria were developed:

- The significance criterion for nitrate (NO_3) concentrations in the Provo River was assessed based on the State of Utah Water Quality Standard for Aesthetics and Aquatic Wildlife of 4 mg/l (Utah Department of Environmental Quality 1991), with a change in nitrate (NO_3) concentration exceeding this concentration considered significant.
- An increase in Deer Creek Reservoir TP concentrations of 0.002 mg/l is significant because it could cause eutrophication.
- Water quality in Deer Creek Reservoir is a function of the reservoir's mixing status (the frequency at which water mixes vertically). Resistance to and the frequency of mixing is determined by thermal stratification, which

occurs when a temperature gradient develops in the reservoir and the difference in density of the layers temporarily prevents mixing. Deeper layers of stratified lakes can be major sources of TP to surface layers when mixing occurs. The water quality issue related to Deer Creek Reservoir temperature is a potential change to the reservoir's stratification during late summer. Late summer mixing would allow the release of phosphorus-rich bottom water to the surface where the phosphorus could promote algae blooms. Therefore, significance criteria of reservoir temperature and mixing status were assessed based on changes to the inflow temperature of the Provo River and maintaining a minimum reservoir depth of about 33 feet. This depth would be necessary for strong thermal stratification during critical late summer periods (Heiskary and Wilson 1990). Deer Creek Reservoir modeling by Woodward-Clyde (1995) indicated that temperatures in the reservoir near the dam are only marginally affected by changes of 18°F or less in the inflow temperature of the Provo River. Therefore, changes to reservoir temperature and mixing status are significant if reservoir depth drops below 33 feet during critical late summer periods and/or Provo River inflow temperatures increase by 18°F or more.

Since there are no state standards for TP and TSS concentrations and loads, no significance criteria for these parameters were developed. Water quality significance criteria were not developed for stream temperatures. Significance for stream temperature is addressed in the Aquatic Resources analysis in Section 3.5.6.1 of Chapter 3 of the PRRP EIS.

3.3.6.2 Potential Impacts Eliminated From Further Analysis

The following water quality issues have been eliminated from further analysis:

- What impacts would occur on water quality from repeated maintenance that could be required with the Proposed Action (Riverine Habitat Restoration) and other alternatives?

  The Proposed Action has been designed to complement natural fluvial and morphological characteristics and to avoid repeated maintenance. Therefore, maintenance is not a water quality issue under the Proposed Action. The Existing Channel Modification and Instream Structures Alternatives require occasional maintenance to reconstruct project features damaged by high flows. However, the expected frequency of such events is low (once every 5 to 10 years), and the extent of disturbance caused by maintenance activities would be minor.

- What water quality impacts would occur from increased human waste due to recreational use?

  Baseline as well as the Proposed Action and alternatives have access points which include restroom facilities. In addition the potential nutrient load from human waste directly entering the river from recreation activities is small compared to the loads in the river. Therefore, human waste from increased recreational activities is not a water quality issue under the Proposed Action or alternatives.

3.3.6.3 Proposed Action (Riverine Habitat Restoration)

The following sections define potential water quality impacts from construction and maintenance of the Proposed Action by impact topic.

3.3.6.3.1 Provo River. The following subsections describe potential water quality impacts on the Provo River under the Proposed Action.

3.3.6.3.1.1 Nutrients and Sediments. Nutrient and sediment concentrations in the Provo River would be affected by construction activities and changes in land use along the river corridor under the Proposed Action.

Construction activities could potentially encounter septic systems, but the number in the construction area is minimal (Hansen, Allen, and Luce 1994) and the PRRP design criteria require construction to be a minimum of 200 feet from any residence. Therefore, the chances of construction activities affecting septic systems are minimal, and the PRRP is not expected to cause an increase in TP and NO_3 migration from septic systems to the Provo River. Water quality impacts from encountering septic systems under the Proposed Action would not occur.

Construction of the Proposed Action may cause soil erosion, which would lead to increases in sediment and associated nutrient concentrations in the Provo River. However, construction activities would cause only negligible amounts of soil to enter the Provo River (see Section 3.8, Soil Resources), based on the methods that would be used to construct this alternative (see PRRP EIS Section 1.7.3 of Chapter 1 for a description of construction procedures, and PRRP EIS Section 1.11.7 for Standard Operating Procedures). The Proposed Action also would be completed in stages, and the amount of construction at any one time would be kept to a minimum. Thus, the Proposed Action could result in an a slight increase in sediment and associated nutrients during and immediately after construction, but it would not be significant.

A total of 169.5 acres of irrigated and nonirrigated agricultural land would be acquired under this alternative above the acreage acquired under baseline (see Table 1-10 in Section 1.11 of Chapter 1 of the PRRP EIS). This land would be fenced, which would exclude livestock and reduce TP loads by an estimated 251 kg/year (552 lb/year). This is about 2 percent of the average annual TP load in the Provo River, which would reduce Provo River average annual TP concentrations by less than 0.001 mg/L. This impact would not be significant but would slightly improve water quality compared to baseline conditions. Land acquisition and fencing also would be expected to cause slight long-term reductions in TSS and NO_3 concentrations.

Ponds created with the side channels under the Proposed Action also may lead to water quality improvements in the Provo River. Eight small ponds, 10 to 15 feet deep and with a total surface area of 5.6 acres, are proposed (see PRRP EIS Section 1.7.2.1 of Chapter 1 for locations). Although these depths would be sufficient to provide sedimentation and storage of TSS and TP, the storage levels cannot be measured and the benefit would be small relative to overall loads and concentrations in the Provo River.

3.3.6.3.1.2 ***Temperature.*** Incident solar radiation on the Provo River would increase under the Proposed Action as cottonwood trees and other types of riparian vegetation are removed, meanders are re-established and the river is lengthened. These changes would increase water temperatures until new trees and other vegetation growing under this alternative become established. New cottonwood trees would mature in about 15 to 30 years as described in Section 3.4.6.3.3, Wetland Resources. Table 3-4 shows the potential water temperature increases in the Provo River from these activities during July of a dry year. Water temperature changes in Reach 1 were not estimated since changes to riparian vegetation in this reach are not part of the Proposed Action. Estimated water temperature increases range from 1.2°F in Reach 5 to 6.2°F in Reach 8. The significance of these changes is described in Section 3.5.6.3.1.1, Aquatic Resources.

Temperature increases in individual reaches are expected to be negligible because narrow side channels (2 to 3 feet wide) would receive significant shade from grasses and riparian vegetation. This would limit the exposure to solar radiation. Temperature increases in the river are less than 0.3°F using worst-case mixing and dilution calculations.

Under the Proposed Action the enhanced riparian corridor would provide more effective shading, which would return water temperatures to baseline levels or slightly lower after vegetation is re-established. The significance of this decrease is described in Section 3.5.6.3.1.1, Aquatic Resources.

3.3.6.3.2 Deer Creek Reservoir. The following subsections describe potential water quality impacts on Deer Creek Reservoir under the Proposed Action.

3.3.6.3.2.1 ***Sediment.*** Minor sedimentation increases in Deer Creek Reservoir during and immediately after construction would be the same as described for the Provo River in Section 3.3.6.3.1.1. However, sediment loads would decrease after construction is completed and land acquired for access is fenced. These reductions would have a positive impact.

3.3.6.3.2.2 ***Eutrophication.*** The Proposed Action would cause minor increases of TP in the Provo River during and immediately after construction (as described in Section 3.3.6.3.1.1). This is not considered significant since it would not increase annual reservoir TP concentrations.

Fencing of land to be acquired under the Proposed Action would cause a minor decrease in TP loads to the reservoir of about 420 kg/year (924 pounds). This would not change TP concentrations in Deer Creek Reservoir, since it is less than 3 percent of the average annual baseline load to the reservoir.

Table 3-4
Proposed Action Temperatures and Impacts by Reach in the Provo River

Reach*		Temperature, ° F
Reach 2	Baseline	55.7
	Proposed Action	61.3
	Difference	5.6
Reach 3	Baseline	53.1
	Proposed Action	56.5
	Difference	3.4
Reach 4	Baseline	56.0
	Proposed Action	58.7
	Difference	2.7
Reach 5	Baseline	59.1
	Proposed Action	60.3
	Difference	1.2
Reach 6	Baseline	54.8
	Proposed Action	60.5
	Difference	5.7
Reach 7	Baseline	52.3
	Proposed Action	58.3
	Difference	6.0
Reach 8	Baseline	54.5
	Proposed Action	60.7
	Difference	6.2
Reach 9	Baseline	53.2
	Proposed Action	58.0
	Difference	4.8

Note:

*Reach 1 was not assessed because the Proposed Action and alternatives do not affect clearing of vegetation in this reach

3.3.6.3.2.3 ***Reservoir Temperature and Mixing Status.*** The Proposed Action would not change the hydrology of Deer Creek Reservoir because it would not change inflow and outflow characteristics of the reservoir from baseline conditions. Therefore, changes in reservoir depth or storage under the Proposed Action would not affect stratification and mixing in the reservoir.

The Proposed Action could temporarily increase inflow temperatures from the Provo River under late summer, dry-year conditions. However, the temperature increase in Reach 2 (closest to Deer Creek Reservoir) of 5.6°F would be less than the significance criteria of an 18°F change from baseline conditions. Therefore, changes in inflow temperature of the Provo River under the Proposed Action would not affect stratification or mixing in Deer Creek Reservoir.

3.3.6.3.3 Impact Summary. The following water quality impacts would occur under the Proposed Action:

- The Proposed Action would cause a minor increase in TSS and TP concentrations in the Provo River during and immediately after construction. However, the SOPs would prevent significant impacts. TSS and TP concentrations in the river would decrease slightly after construction and fencing of acquired land is completed. This would have a positive impact.
- Until new vegetation is established, the loss of riparian vegetation and associated shading and the addition of more river surface area could increase late summer stream temperatures from 1.2˚F in Reach 5 to 6.2˚F in Reach 8 Water temperatures would decrease to or slightly below baseline levels after vegetation matures. The significance of these changes is evaluated in Section 3.5, Aquatic Resources.
- A minor increase in annual TSS loads to Deer Creek Reservoir would occur during and immediately following construction. However, the SOPs are expected to prevent significant impacts. TSS loads to the reservoir would decrease slightly after construction and fencing of acquired land is completed. This would have a positive impact.
- A minor increase in annual TP loads to Deer Creek Reservoir would occur during and immediately after construction. However, SOPs are expected to prevent significant impacts. TP loads to the reservoir would drop by about 420 kg/yr (924 pounds) after construction and fencing of acquired land is completed. This reduction would not change the average annual TP concentration in the reservoir.
- The Proposed Action would not change the mixing status or stratification of Deer Creek Reservoir.

3.3.6.4 Existing Channel Modification Alternative

The following sections define potential water quality impacts from construction of the Existing Channel Modification Alternative by impact topic.

3.3.6.4.1 *Provo River.* The following subsections describe potential water quality impacts on Deer Creek Reservoir under the Existing Channel Modification Alternative.

3.3.6.4.1.1 ***Nutrients and Sediments.*** Construction of this alternative would cause soil erosion, leading to increases in TSS and TP concentrations in the Provo River. However, the Soil Resources analysis (Section 3.8 of the PRRP EIS) concludes that construction of this alternative would only cause negligible amounts of soil to enter the Provo River. This alternative would acquire only 7.6 acres of agricultural land above that acquired under baseline conditions. This land would be fenced and exclude livestock, but there would be a negligible increase in TP and TSS loads in the Provo River and no change in concentrations. Therefore, the Existing Channel Modification Alternative would cause a minor increase in TSS and TP concentrations during and immediately after construction, but would not change concentrations over the long-term once construction is complete.

3.3.6.4.1.2 ***Temperature.*** Construction of this alternative would increase Provo River temperatures as described in Section 3.3.6.3.1.2 for the Proposed Action, except temperature increases would range from 0°F in Reaches 4 and 5 to 5.4°F in Reach 8 (see Table 3-5) before returning to approximately baseline levels after vegetation is re-established.

3.3.6.4.2 Deer Creek Reservoir. The following subsections describe potential water quality impacts

Table 3-5
Existing Channel Modification Temperatures and Impacts by Reach in the Provo River

Reach*		Temperature °F
Reach 2	Baseline	55.7
	PRRP ECM	59.0
	Difference	3.3
Reach 3	Baseline	53.1
	PRRP ECM	56.8
	Difference	3.7
Reach 4	Baseline	56.0
	PRRP ECM	56.0
	Difference	0.0
Reach 5	Baseline	59.1
	PRRP ECM	59.1
	Difference	0.0
Reach 6	Baseline	54.8
	PRRP ECM	56.9
	Difference	2.1
Reach 7	Baseline	52.3
	PRRP ECM	56.0
	Difference	3.7
Reach 8	Baseline	54.5
	PRRP ECM	59.9
	Difference	5.4
Reach 9	Baseline	53.2
	PRRP ECM	55.9
	Difference	2.7

Note:

*Reach 1 not assessed because the Proposed Action and alternatives do not affect clearing of riparian vegetation in this reach on Deer Creek Reservoir under the Exiting Channel Modification Alternative.

3.3.6.4.2.1 ***Sediment.*** Minor increases in TSS concentrations to Deer Creek Reservoir during and immediately after construction of this alternative would be the same as described in Section 3.3.6.4.1.1 for the Provo River.

3.3.6.4.2.2 ***Eutrophication.*** Increases in TP loads to Deer Creek Reservoir during and immediately after construction of this alternative are minor as described in Section 3.3.6.4.1.1. These loads would not be significant because they would not increase annual reservoir TP concentrations.

3.3.6.4.2.3 ***Reservoir Temperature and Mixing Status.*** This alternative would not change the hydrology of Deer Creek Reservoir because it would not change inflow and outflow characteristics of the reservoir from baseline conditions. Therefore, changes in reservoir depth or storage under this alternative would not affect stratification and mixing.

Temporary increases of inflow water temperatures from the Provo River would be less than 3.3°F, well below the significance criteria of 18°F. Therefore, the alternative would not change stratification or mixing in Deer Creek Reservoir.

3.3.6.4.3 **Impact Summary.** The following water quality impacts would occur under the Existing Channel Modification Alternative:

- There would be a minor increase in TSS and TP concentrations in the Provo River during and immediately after construction. However, SOPs would prevent significant impacts.
- Until new vegetation matures, the loss of riparian vegetation and associated shading, along with greater river surface area could increase late summer stream temperatures from 0° in Reaches 4 and 5 to 5.4°F in Reach 8. Water temperatures would drop to near baseline levels after vegetation becomes established. The significance of this change is evaluated in Section 3.5, Aquatic Resources.
- There would be a minor increase in annual TSS loads to Deer Creek Reservoir during and immediately after construction. However, SOPs would prevent significant impacts.
- There would be a minor increase in annual TP loads to Deer Creek Reservoir during and immediately following construction. However, SOPs would prevent significant impacts and the increased loading would not change the average annual TP concentration in the reservoir.

3.3.6.5 Instream Structures Alternative

The following sections define potential water quality impacts from construction of the Instream Structures Alternative by impact topic.

3.3.6.5.1 Provo River. The following subsections describe potential water quality impacts on the Provo River under the Instream Structures Alternative.

3.3.6.5.1.1 Nutrients and Sediments. Construction of this alternative has the potential to affect nutrient and sediment concentrations in the Provo River, but would not affect adjacent land uses.

Construction could cause some erosion and lead to minor increases in TSS and TP concentrations in the Provo River. However, since construction would be minimal, negligible amounts of soil would enter the Provo River (see Soil Resources analysis (Section 3.8). Therefore, minor increases in TSS and TP during and immediately after construction would not be significant.

3.3.6.5.1.2 ***Temperature.*** This alternative would involve very little clearing of riparian vegetation and would not affect stream temperatures.

3.3.6.5.2 ***Deer Creek Reservoir.*** The following subsections describe potential water quality impacts on Deer Creek Reservoir under the Instream Structures Alternative.

3.3.6.5.2.1 ***Sediment.*** Minor sedimentation in Deer Creek Reservoir during and immediately after construction of this alternative would be the same as described for the Proposed Action in Section 3.3.6.3.1.1.

3.3.6.5.2.2 ***Eutrophication.*** Minor increased migration of particulate phosphorus (i.e., that fraction of TP attached or incorporated in particulate matter) to Deer Creek Reservoir during and immediately after construction of this alternative would be the same as described for the Proposed Action in Section 3.3.6.3.2.2.

3.3.6.5.2.3 Reservoir Temperature and Mixing Status. The Instream Structures Alternative would not change the hydrology of Deer Creek Reservoir because the alternative would not change inflow and outflow characteristics of the reservoir from baseline. Therefore, changes in depth or storage under this alternative would not affect stratification and mixing in the reservoir.

This alternative would not affect inflow temperatures from the Provo River. Therefore, temperatures in the reservoir would not be impacted.

3.3.6.5.3 Impact Summary. Water quality impacts under the Instream Structures Alternative would be the same as described for the Existing Channel Modification Alternative in 3.3.6.4.3, except there would be no significant change in the riparian corridor, associated shading or river surface area, so water temperatures would not change from baseline.

3.3.6.6 No Action Alternative

The No Action Alternative would have no impacts on water quality. Baseline water quality conditions would continue as described in Section 3.3.5.

3.4 Wetlands Resources

3.4.1 Introduction

The PRRP wetlands analysis addresses potential impacts on wetlands from the construction, operation and maintenance of the Proposed Action and alternatives. The information and analysis documented in this section were summarized from the Draft Wetlands Technical Report (CUWCD 1996d. The analysis in this section of Chapter 3 focuses on all potential wetland types that could be impacted, including direct, indirect, short-term (during construction) and long-term (permanent) impacts to wet and moist meadows, emergent marshes, shrub wetlands and riparian woodland. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.3.

The following wetland impact topics are addressed in the impact analysis:

- Impacts on wetland types from construction of the PRRP
- Impacts on wetland types from changes in the water table
- Impacts on wetland types from changes in surface-water flow

3.4.2 Issues Eliminated From Further Analysis

None of the wetland issues raised during scoping and defined in Section 3.4.3 have been eliminated from further analysis.

3.4.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- How would construction of the PRRP impact wetlands?
- How would changes in the water table impact wetlands?
- How would changes in surface-water flow impact wetlands?

3.4.4 Description of Impact Area of Influence

The wetland resource impact area of influence consists of about 10 miles of the Provo River corridor between Jordanelle Dam and Deer Creek Reservoir. Map 3-1 in Section 3.1.1.1 of this EIS shows the impact area of influence by river reach.

3.4.5 Affected Environment (Baseline Conditions)

Wetlands types in the Provo River corridor include wet and moist meadows, emergent marshes, shrub wetlands and riparian woodland. Section 3.4.5 in Chapter 3 of the WCWEP and DRP EIS describes the five wetland community types that would be potentially impacted by the PRRP Proposed Action and alternatives. Additional information is presented in the following subsection for the riparian woodland community type along the Provo River corridor. Map A-3 (in pocket at back of EIS) shows the wetland community types and Map 3-1 in Section 3.1.1.1 shows the impact area of influence.

3.4.5.1 Riparian Woodland. Riparian woodland as mapped for baseline conditions contains 25 percent wetland. Large areas of riparian woodland are found in the following areas: up to 800 feet from the river and levees in the northern part of Heber Valley near the USBR mitigation wetlands; near the crossing by River Road; and from 1 mile upstream to one-half mile downstream of the Midway Road crossing. In other areas, riparian woodlands are mostly confined to a narrow strip along the banks of existing dikes. Riparian woodlands along the Provo River are natural, but are reduced from larger riparian woodlands that existed 40 years before the river was channelized and interaction with the floodplain was limited. Since the dikes have been constructed, there has been very little new cottonwood tree recruitment in areas separated from the existing channel. Many existing cottonwoods are about the same age. Natural cottonwood recruitment depends on the dynamics of flood flows that cause surface scour and sediment deposition. (Hill et al 1986; Padgett et al 1989; Bradley et al 1985). This interaction has been mostly eliminated since the dikes were constructed.

3.4.5.2 Wet Meadow — USBR Wetlands. The USBR wetlands were designed and constructed as mitigation for wet meadow wetland impacts when the Jordanelle Dam and Reservoir were constructed and Highway 40 was relocated. USBR constructed wetland cells on about 134 acres of lands adjacent to the Provo River below the Jordanelle Dam and south of relocated Highway 40. The cells provide open-water habitat (including for spotted frog), emergent vegetation and sedge meadows, and are separated by constructed dikes. Water rights for the wetlands were secured by USBR when land was purchased at Jordanelle Reservoir. The water supply to individual wetland cells and water levels in each cell are controlled by weirs constructed in the dikes. USBR is continuing its efforts to develop these wetlands to meet the Project 404 Permit stipulations.

3.4.6 Impact Analysis

3.4.6.1 Significance Criteria

The wetland significance criteria for the Proposed Action and alternatives are the same as described in Section 3.4.6.1 in the WCWEP and DRP EIS. The following describes the types of wetland impacts that could occur under the Proposed Action and alternatives:

- Direct impacts, which would result from construction activities that physically disturb wetland vegetation, soils and hydrology
- Short-term impacts, which are disturbances to wetlands that would be restored after project construction.
- Long-term impacts, which would result from construction of a permanent project feature (such as the river channel, setback dikes and floodplain construction) in a wetland. Long-term impacts would require mitigation or project wetland benefits to replace impacted areas.
- Beneficial impacts, which are wetlands and riparian woodlands that would be developed as part of the project construction.

3.4.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential wetland impacts have been eliminated from further analysis.

3.4.6.3 Proposed Action (Riverine Habitat Restoration)

Overall, the Proposed Action would have short-term adverse impacts on 24.7 acres of wetlands during construction, while 74.2 acres of wetlands would be permanently removed and 292.5 acres of integrated riparian woodland, open-water and wet/moist meadow and emergent marsh wetlands would be created. The USBR wetland areas and any cottonwood trees that would be adversely impacted under the Proposed Action are categorized separately. Map A-10 (in pocket at back of EIS) shows long-term adverse impacts on wetlands (short-term adverse impacts are excluded from the map for clarity). These impacts were based on the feasibility level design (see Chapter 1, Section 1.7). During final design, steps would be taken to reduce the level of wetland impacts to the extent possible. The only beneficial impacts shown on Map A-10 are the ponds and side channels.

There would be no significant changes to wetlands from the potential rise in groundwater elevations in Reaches 7, 8 and 9 based on results of the hydrology analysis presented in Section 3.2, Water Resources.

The following subsections describe the direct short and long-term impacts on each wetland type from construction and operation of the Proposed Action.

3.4.6.3.1 Wet/Moist Meadow Complex. The wet/moist meadow complex is mapped as 80 percent wetland for wet meadows and 10 percent wetland for moist meadows. The adverse impact calculations account for these percentages. A total of 19.6 acres of wet/moist meadow would receive direct short-term impacts during construction of the Proposed Action until they are restored under the SOPs described in Section 1.11.7 of PRRP EIS Chapter 1. The short-term impacts would include disturbance and removal of vegetation and soils by construction equipment.

Wetland functions, including groundwater recharge, and wildlife habitat, would be impacted during the short-term until the wetlands are restored to a functioning state.

Under the Proposed Action, 52.4 acres of wet/moist meadow wetlands would be removed by the construction of the river channel, floodplain construction and placement of setback dikes. This includes 26.1 acres of the USBR replacement wetlands developed as mitigation for the Jordanelle Dam project. About 12.4 acres of mitigation wetlands would be removed in the southern replacement wetland cells below the US Highway 40 overpass and 13.7 acres would be removed in the northern cells below Jordanelle Dam. Map A-10 (see pocket at back of EIS) shows the impacted portions of the USBR replacement wetlands. The remaining 26.3 acres of wet/moist meadow permanently removed under the Proposed Action are scattered throughout the nine PRRP reaches (see Map A-10 in pocket at back of EIS). Proposed mitigation for these impacts is described in Section 3.19.2.

Aside from the USBR replacement wetlands, impacted wet/moist meadow wetlands have functional values ranging from very low to relatively high. Low-value wetlands that would be removed by construction of the Proposed Action are comprised of irrigated agricultural fields used mainly for hay production and pasture. These wetlands have the following characteristics: 1) they are relatively flat and interspersed throughout upland areas; 2) wetland species are dominated by Nebraska sedge, Kentucky bluegrass and reed canary grass; 3) the water source consists of flood irrigation or irrigation drainage and return flow that collects on the surface — in some cases because it is blocked by dikes from reaching the river; and 4) many of the low-functioning agricultural wetlands are grazed by livestock. Higher-value wetlands are composed of a mosaic of wetland community types that include diverse topography, a wide range of water regimes, organic soils and a diversity of plant communities. Some wet/moist meadow wetlands provide potential habitat for threatened, endangered and candidate species, including Ute Ladies'-tresses, peregrine falcon and spotted frog (see Section 3.7 Threatened, Endangered, and Candidate Species).

Approximately 16.3 acres of wet/moist meadow complexes would be enhanced by running water through about 10.7 miles of side channel, which would increase soil moisture in adjacent banks to support wet meadow vegetation. The enhancement would likely occur over two to three growing seasons as the vegetation responds to the increased soil moisture. The 16.3 acres includes the channel and a strip of enhanced vegetation estimated for calculation purposes to be 5 feet wide. In reality, enhanced vegetation would be wider in some locations and narrower in others depending on the micro-topography, channel slopes, soils and vegetation species. The side channels are expected to support vegetation overhanging the channel banks and lining the channel bottom because livestock grazing would be eliminated in these areas and flow velocities would be low. The 16.3 acres of wet/moist meadow that would be enhanced would provide potential habitat for threatened, endangered and candidate species, including Ute Ladies'-tresses, peregrine falcon and spotted frog (see Section 3.7 Threatened, Endangered, and Candidate Species).

3.4.6.3.2 Emergent Marsh. A total of 2.6 acres of emergent marsh vegetation, soils and hydrology would be temporarily disrupted to develop a floodplain and to construct the new river channel under the Proposed Action. Wetland functions, including groundwater recharge and wildlife habitat, would be impacted for 2 years until the emergent marsh areas are restored to a functioning state.

Excavation of the new channel and placement of fill in emergent marsh wetlands for construction of new flood dikes would permanently eliminate 2.8 acres of emergent marsh. Highly rated wetland functions that would be eliminated include groundwater discharge, wildlife diversity and uniqueness/heritage.

An estimated 4.3 acres of emergent marsh would be created over an estimated three years around the perimeter of open-water ponds under the Proposed Action. The estimated acreage was calculated from the conceptual layout (See Map A-10 in pocket at the back of EIS). These ponds and emergent marsh sizes and locations are conceptual, therefore the actual acreage could be different after final design. Wetland functions such as sediment stabilization and wildlife and aquatic habitat would develop as these wetlands mature into functioning ecosystems.

3.4.6.3.3 Riparian Woodland. About 9.7 acres of riparian woodland and an additional 1,216 mature cottonwood trees would be permanently lost when dikes are removed and the existing river channel is abandoned during construction of the Proposed Action. During final design, impacts on cottonwood trees would be avoided when feasible. Highly rated wetland functions that would be impacted include sediment stabilization, wildlife diversity and uniqueness/heritage.

About 256.5 acres of riparian woodland habitat would be created naturally along the banks of the new river channel and on about 50 percent of the 2-year floodplain Under the operation of Jordanelle Reservoir, the 2-year floodplain would be inundated every other year at average flow depths ranging from 0.1 to 0.5 feet and average velocities ranging from 0.5 to 1.5 feet per second. Topographic variations (e.g., depressions, traces of abandoned channels and obstructions such as trees) would cause localized areas of greater depths and velocities. The assumption was made that these flows would develop soil and hydrology conditions to support natural recruitment of cottonwood and willow species. It would take an estimated 15 to 30 years for cottonwood trees to mature to levels comparable to existing trees being removed. However, cottonwood recruitment would occur incrementally over a number of overbank flood cycles, resulting in a riparian zone of various heights and stages of development rather than a strip of vegetation that is all similar in age and development as presently exists. Creation of a successional riparian zone would produce diverse wildlife and aquatic habitats in the long term.

3.4.6.3.4 Shrub Wetland. A total of 2.5 acres of shrub wetland would be removed or disturbed during construction of the Proposed Action. Short-term impacts include removal or disturbance of vegetation, soils and hydrology during construction of the new river channel, floodplain and setback dikes. After construction is completed the impacted areas would be restored under the SOPs described in Section 1.11.7 of PRRP EIS Chapter 1. Highly rated wetland functions, including sediment stabilization and wildlife habitat values, would be impacted during construction and until the shrub wetland areas are restored over 3 to 5 years.

A total of 9.3 acres of shrub wetland would be permanently removed when existing dikes are removed and the existing river channel is abandoned Construction would remove dogwood, willows and herbaceous understory vegetation primarily in Reach 4. Highly rated functions of these shrub wetlands, sediment stabilization and wildlife diversity/abundance would be eliminated during construction of the Proposed Action.

An estimated 9.8 acres of new shrub wetlands would likely establish on point bars and terraces as the new channel develops into a functioning river system. This is about half of the total point bar area that is estimated would be created under the Proposed Action. The remaining point bar area would be subject to flooding levels and flow velocities unfavorable for maintaining shrub vegetation.

3.4.6.3.5 Open Water. About 5.6 acres of open-water ponds would be constructed in conjunction with side channels under the Proposed Action. The pond depths described in Chapter 1 and configurations shown on Map A-10 (in the pocket at back of EIS) are conceptual and may be revised in final design. Open water is not a wetland type, but it provides habitat associated with many wetland emergent and submergent plant species and animal species, such as waterflowl and small mammals (i.e., beaver, muskrat, etc.) The ponds would be developed to add biodiversity throughout the river corridor.

3.4.6.3.6 Impact Summary. The Proposed Action would directly impact 24.7 wetland acres during construction and until the wetlands are fully restored under the SOPs described in Section 1.11.7 of Chapter 1. A total of 74.2 wetland acres (including 26.1 acres of USBR wetlands) would be permanently removed by the construction under the Proposed

Action. Specific mitigation for impacts to USBR wetlands is described in Section 3.19.2.

About 256.5 acres of riparian woodland would develop over a 3- to 30-year period on channel banks and covering about half of the new 2-year floodplain. The amount of this acreage that would develop jurisdictional wetland qualities cannot be quantified at this time. However, during the final design phase of the Proposed Action, areas would be designed to facilitate such natural wetland development.

About 16.3 acres of wet meadow would be developed or enhanced by running water through side channels. Construction of ponds would create about 9.9 acres of open water and emergent marsh. About 9.8 acres of shrub wetland would develop on channel point bars.

Wet/moist meadow vegetation would be impacted most, while riparian woodland vegetation would benefit most under the Proposed Action. Creation of riparian woodland habitat along the river corridor would result in development of higher rated functions compared with the functions lost from permanent removal of wet/moist meadows that are irrigation-induced wetlands in agricultural fields. Functions that are expected from development of the riparian woodland include: diversity of plant species, including cottonwood overstory, shrub species and herbaceous layer; diverse wildlife habitats, improved aquatic habitat due to shading and diverse bank vegetation; and habit for threatened, endangered and candidate species (i.e., bald eagle, peregrine falcon, Ute ladies'-tresses and spotted frog).

Tables 3-6, 3-7 and 3-8 summarize short-term construction impacts; permanent wetland impacts from replacing wetlands with project features; and wetland benefits created under the Proposed Action. Table 3-8 summarizes the wetland impacts and benefits under the Proposed Action.

3.4.6.4 Existing Channel Modification Alternative

Existing wetlands would not be impacted by changes in the groundwater table or surface water flow from construction of the Existing Channel Modification

Table 3-6
Temporary Direct Adverse Wetland Impacts That Would Occur During Construction of the Proposed Action

	Wetland Area Adversely Impacted — by Community Type			
Reach	**Wet/Moist Meadow (acres)**	**Emergent Marsh (acres)**	**Shrub Wetland (acres)**	**Total Wetlands Impacted (acres)**
1	0.0	0.0	0.0	0.0
2	1.3	0.0	0.0	1.3
3	0.4	0.0	0.9	1.3
4	1.5	0.0	0.8	2.3
5	0.5	0.2	0.3	1.0
6	0.8	0.0	0.0	0.8
7	7.1	2.3	0.0	9.4
8	3.7	0.0	0.2	3.9
9	4.3	0.1	0.3	4.7
Total	**19.6**	**2.6**	**2.5**	**24.7**

Notes:

The temporary wetland impacts shown in this table would be restored under the SOPs after construction is completed.

Table 3-7
Permanent Removal of Wetlands From Construction Under the Proposed Action

Wetland Area Adversely Impacted — by Community Type							
Reach	**WM/MM[a] (acres)**	**EM[b] (acres)**	**RW[c] (acres)**	**Shrub[d] (acres)**	**USBR[e] WM (acres)**	**Total Wetlands Impacted (acres)**	**CW[f] (Number of trees removed)**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3.6	0.0	0.0	0.0	0.0	3.6	140
3	0.7	0.0	3.1	1.0	0.0	4.8	79
4	0.0	0.0	6.0	6.8	0.0	12.8	0
5	1.2	0.7	0.4	0.5	0.0	2.8	119
6	3.0	0.0	0.0	0.0	0.0	3.0	249
7	12.4	2.0	0.0	0.0	0.0	14.4	74
8	3.0	0.0	0.2	0.5	12.4	16.1	18
9	2.4	0.1	0.0	0.5	13.7	16.7	537
Total	**26.3**	**2.8**	**9.7**	**9.3**	**26.1**	**74.2**	**1,216**

Notes:

[a] WM/MM = wet meadow/moist meadow
[b] EM = emergent marsh
[c] RW = riparian woodland
[d] Shrub = shrub wetland
[e] USBR = United States Department of the Interior, Bureau of Reclamation
[f] CW = cottonwood trees.

Table 3-8
Wetlands and Open Water Created Under the Proposed Action

Wetland Area Created — by Community Type						
Reach	River Bank RW (acres)[a]	Point Bars Shrub[b] (acres)	Emergent Marsh (acres)	Ponds O W (acres)	Side Channels[c] WM (acres)	Total Created Wetlands (acres)
1	0.0	0.0	0.0	0.0	0.0	0.0
2	33.0	0.7	0.5	0.6	2.6	37.4
3	41.7	1.9	0.0	0.0	1.7	45.3
4	43.3	1.3	0.4	0.5	1.5	47.3
5	21.3	0.9	0.5	0.3	1.6	24.6
6	49.9	1.8	1.3	2.2	4.8	60.0
7	17.0	0.9	0.0	0.0	1.5	19.1
8	20.7	0.8	1.6	2.0	1.5	26.6
9	29.6	1.5	0.0	0.0	1.1	32.2
Total	**256.5**	**9.8**	**4.3**	**5.6**	**16.3**	**292.5**

Notes:

WM = wet meadow; RW = riparian woodland; EM = emergent marsh; OW = open water

[a] Riparian woodland habitat created along the banks of new channel alignment = a canopy cover over about one-half of the meander belt width along the length of the new river alignment

[b] Shrub wetlands are assumed to develop on the upper portion of point bars on all inside meanders above the line of inundation.

[c] Side channel area calculation = channel length x 12.5 feet width, which includes a 2.5 foot wide channel and an estimated 5-foot width of enhanced area on each side of the channel

Table 3-9
Summary of Wetland Impacts and Benefits Under the Proposed Action

Impact Type	Wet/Moist Meadow (acres)	Emergent Marsh (acres)	Open Water (acres)	Riparian Woodland (acres)	Shrub Wetland (acres)	Total (acres)
Temporary direct adverse impacts restored under SOPs	19.6[a]	2.6[a]	0.0	0.0	2.5[a]	**24.7**
Wetlands eliminated[b]	-52.4	-2.8	0.0	-9.7	-9.3	**-74.2**
Wetlands enhanced under Proposed Action	+16.3	0.0	0.0	0.0	0.0	**+16.3**
Wetlands created under Proposed Action	0.0	+4.3	+5.6	+256.5	+9.8	**+276.2**
[a] **Net change in wetland acres**	**-36.1**	**+1.5**	**+5.6**	**+246.8**	**+0.5**	**+218.3**

Notes:

[a] The acres of direct adverse impacts that would be restored under the SOPs are not included in the calculation to figure net change in wetland acres.

[b] Wetlands would be eliminated incrementally as each reach is constructed.

Alternative based on results of the hydrology analysis presented in Section 3.2, Water Resources.

A total of 116.8 acres of wet/moist meadow and shrub wetlands would be adversely impacted by equipment operating in wetland areas during construction of the Existing Channel Modification Alternative. Wetland vegetation and soils would be disturbed and removed in the construction corridor, which includes a zone 50 feet wide on each side of the existing channel over 9.6 miles in the Reaches 2 through 9. The 50-foot wide construction corridor is outside the existing dikes where the new setback dikes would be constructed. After completion, these wetland areas would be restored under the SOPs over a 2- to 3-year period. Construction impacts are greater under this alternative than under the Proposed Action because there are more setback dikes constructed and a greater acreage of floodplain grading.

Wetlands would be permanently removed and created under this alternative. About 63.1 acres of wetlands and 1,080 mature cottonwoods would be permanently removed during construction of this alternative. Wetlands that would be removed include wet/moist meadows and riparian woodlands that receive water from a variety of sources, including irrigation ditches, flood irrigation runoff, sub-irrigation, snowmelt runoff, groundwater discharge and the Provo River (see Map A-11 in pocket at back of EIS for locations of impacted wetland types and areas for each river reach). About 141.9 acres of riparian woodland would be created under this alternative. The benefit-to-impact ratio would be 2 to 1 for wetland benefits to wetland impacts under the Existing Channel Modification Alternative.

3.4.6.4.1 Wet/Moist Meadow Complex. A total of 100.9 acres of wet/moist meadow would be adversely impacted during construction of the this alternative. Disturbance or removal of vegetation and soils would be a short-term impact during construction and until the areas are restored under the SOPs.

A total of 22.9 acres of wet/moist meadow complex would be eliminated by construction of this alternative. Wetland vegetation and organic wetland soils would be removed, and hydrology would be altered by floodplain grading and placement of fill material in wet/moist meadow areas for construction of new flood dikes. The impact on wet meadow wetland functions under the Existing Channel Modification Alternative would be the same as described for the Proposed Action in Section 3.4.6.3.1

3.4.6.4.2 Riparian Woodland. About 37.6 acres of riparian woodland and 1,080 mature cottonwoods would be eliminated by construction of this alternative. Cottonwood, box elder, hawthorns and herbaceous understory vegetation would be eliminated during removal of existing dikes. The impact on riparian woodland functions under the Existing Channel Modification Alternative would be the same as described for the Proposed Action in Section 3.4.6.3.3.

Approximately 141.9 acres of riparian woodland habitat would be created over a 3 to 30-year period under the Existing Channel Modification Alternative. The riparian woodland habitat would be created through natural colonization and regeneration, covering the new floodplain between the river and the new setback dikes. Under the operation of Jordanelle Reservoir, the floodplain would be flooded every other year at average flow depths and ranging from 0.1 to 0.5 feet and average velocities ranging from 0.5 to 1.5 feet per second. The assumption was made that these flows would develop soil and hydrology conditions to support natural recruitment of cottonwood and willow species. It would take an estimated 15 to 30 years for cottonwood trees to mature to levels comparable to existing trees, however the vegetation would develop structural diversity much faster, providing habitat for many species much sooner than the 15 to 30 year period. Wetland functions would develop incrementally as the riparian vegetation becomes established and matures.

3.4.6.4.3 Shrub Wetland. A total of 15.9 acres of shrub wetland would be adversely impacted by disturbance or removal of vegetation and soils during construction of this alternative. The impacts would be short term during construction and until the areas are restored under the SOPs.

A total of 2.6 acres of shrub wetland would be eliminated by construction of this alternative. Willows and other shrub species would be removed, and hydrology would be altered by construction of channel modifications. Wetland functions effected include wildlife habitat diversity and sediment stabilization.

3.4.6.4.4 Impact Summary. Construction of the Existing Channel Modification Alternative would cause direct wetland impacts that include removal of 63.1 acres of wetland vegetation (riparian woodland and wet/moist meadow) and an additional 1,080 mature cottonwood trees. Table 3-10 summarizes, by reach and wetland type, the short-term, adverse construction impacts. Table 3-11 shows the wetland acreage that would be permanently removed under this alternative. About 141.9 acres of riparian woodland would be created over 3 to 30 years in the new floodplain compared to a loss of 37.6 acres of this wetland type. Table 3-12 summarizes the wetland benefits by reach. Table 3-13 summarizes the wetland impacts and benefits under the Existing Channel Modification Alternative.

3.4.6.5 Instream Structures Alternative

Groundwater elevations would not increase under this alternative, therefore no change in existing wetlands would occur.

This alternative would have no measurable adverse impacts on wetlands or wetland functions and values because construction would be confined mostly in the present river channel. Minor amounts of shrub and herbaceous bank vegetation would be cleared when necessary to construct the instream structures. SOPs would be implemented to avoid impacts on wetlands and other vegetation. Minor disturbed areas would be revegetated after construction.

3.4.6.6 No Action Alternative

The annual maintenance of dikes and diversions in and along the Provo River channel would continue under the No Action Alternative. These activities would continue to adversely impact riparian woodland in these areas.

Many existing wetlands along the river corridor are non-jurisdictional and therefore are not regulated or protected under Section 404 of the Clean Water Act. These wetlands are subject to loss from future development, land-use changes, modification of water management practices and deliberate drainage under the No Action Alternative.

Table 3-10
Temporary Direct Adverse Wetland Impacts That Would Occur During Construction Under the Existing Channel Modification Alternative

	Wetland Area Impacted — by Community Type		
Reach	**Wet/Moist Meadow (acres)**	**Shrub Wetland (acres)**	**Total Area (acres)***
1	0.0	0.0	0.0
2	12.6	0.0	12.6
3	17.2	0.0	17.2
4	0.0	15.9	15.9
5	10.2	0.0	10.2
6	20.0	0.0	20.0
7	10.9	0.0	10.9
8	10.6	0.0	10.6
9	19.4	0.0	19.4
Total	**100.9**	**15.9**	**116.8**

Note:

* The impacts have been calculated by multiplying the length of the river (per reach) times 100 feet (50 feet each side of the river). This area makes up the construction corridor that would be impacted during project construction and restored after construction by the SOPs.

Table 3-11
Permanent Removal of Wetlands From Construction Under the Existing Channel Enhancement Alternative

Wetland Area Adversely Impacted — by Community Type					
Reach	**Wet/Moist Meadow (acres)**	**Riparian Woodland (acres)**	**Shrub Wetland (acres)**	**Total Area (acres)***	**Cottonwood Trees (number lost)**
1	0.0	0.0	0.0	0.0	0.0
2	2.3	8.6	0.0	10.9	140
3	3.8	10.1	0.0	13.9	170
4	0.0	0.0	2.6	2.6	0.0
5	0.0	0.0	0.0	0.0	0.0
6	2.3	1.3	0.0	3.6	135
7	0.9	2.5	0.0	3.4	55
8	9.1	8.7	0.0	17.8	230
9	8.6	6.4	0.0	10.9	350
Total	**22.9**	**37.6**	**2.6**	**63.1**	**1,080**

Note:

* The impacted areas were calculated using maps that show project features related to locations of wetlands identified from wetlands mapping and field investigations.

Table 3-12
Wetlands Created Under the Existing Channel Modification Alternative

Reach	**Stream Reach (linear feet)**	**Area of Floodplain (Riparian Woodland) (acres)**
2	5,500	10.0
3	7,510	21.1
4	No dikes*	0.0
5	4,440	13.8
6	8,720	24.9
7	4,730	11.4
8	4,600	36.5
9	8,460	24.2
Total	43,960	**141.9**

Note:

* Reach 4 would have no new riparian woodland and existing riparian woodland would continue at baseline levels.

The riparian woodland area is calculated by multiplying the average width of the floodplain in each reach by the linear feet of stream in the reach.

Table 3-13
Summary of Wetland Impacts and Benefits Under the Existing Channel Modification Alternative

Impact Type	Wet/Moist Meadow (acres)	Riparian Woodland (acres)	Shrub Wetland (acres)	Total (acres)
Temporary direct adverse impacts restored under SOPs	100.9[a]	0.0	15.9	116.8
Wetlands eliminated	-22.9	-37.6	-2.6	-63.1
Wetlands created under Existing Channel Modification Alternative	0.0	+141.9	0.0	+141.9
Net Change in Wetland Acres[a, c]	**-22.9**	**+104.3**	**-2.6**	**+78.8**

Notes:

[a] The acres of direct adverse impacts that would be restored under the SOPs are not included in the calculation to figure net change in wetland acres.

[b] Wetlands would be eliminated incrementally as each reach is constructed.

[c] Wetlands would be created incrementally over 3 to 30 years after each reach is constructed.

3.5 Aquatic Resources

3.5.1 Introduction

The aquatic resources analysis addresses potential impacts on aquatic resources from the construction of the Proposed Action and alternatives. The information and analysis documented in this section was summarized from the Draft Aquatic Resources Technical Report (CUWCD 1996a), which is available from CUWCD upon request. The focus of the analysis is on game fish and their habitat, non-game fish and their habitat, and other aquatic resources. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.4. The following aquatic resources impact topics are addressed in the impact analysis:

- Game fish (trout) and their habitat
- Non-game fish and their habitat, including potential impacts on aquatic species of special concern
- Other aquatic resources (i.e., amphibians and macroinvertebrates)

3.5.2 Issues Eliminated From Further Analysis

None of the aquatic resources issues raised during scoping and defined in Section 3.5.3 have been eliminated from further analysis.

3.5.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What opportunities would the project have for developing side channels to benefit fish spawning and rearing?
- What would be the impacts on fish, fish habitat, and other aquatic resources from the PRRP?

3.5.4 Description of Impact Area of Influence

The impact area of influence for evaluating potential impacts of the Provo River Restoration Project (PRRP) on aquatic resources is the Provo River from the outlet of Jordanelle Reservoir downstream to Deer Creek Reservoir. The Provo River was divided into nine stream reaches for describing baseline conditions and potential impacts under the Proposed Action and alternatives. Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence.

3.5.5 Affected Environment (Baseline Conditions)

3.5.5.1 Game Fish and Their Habitat

Three species of game fish were identified during field surveys in the Provo River, including brown trout, rainbow trout and mountain whitefish (see Table 3-30 in Section 3.5.5.1 of the WCWEP and DRP EIS). Habitat requirements for these species are described in Section 3.5.5.1 of the WCWEP and DRP EIS. The following subsections describe the game fish present in the impact area of influence, baseline habitat quality attribute ratings, and baseline predicted trout standing crop.

3.5.5.1.1 Game Fish Occurrence Under Existing Conditions. The following paragraphs describe the occurrence of game fish in the Provo River based on July 1993 field surveys. These surveys represent existing conditions prior to the establishment of 125 cfs minimum instream flow under baseline conditions and are appropriate as a general indication of game fish occurrence in the Provo River.

Brown trout were the predominant game fish collected during the surveys and were present in each stream reach sampled. Rainbow trout were the next most abundant game fish species, though at considerably lower numbers compared to brown trout. Most rainbow trout were collected from the lowest reach of the Provo River just upstream from Deer Creek Reservoir. Mountain whitefish were collected throughout the Provo River.

3.5.5.1.2 Baseline Habitat Quality Attribute Ratings. The Binns HQI Model II baseline habitat attribute ratings (described in Section B.3.4.2.1 of Appendix B) were developed during field surveys and include quantitative measurements as well as best professional judgment. The overall results of the baseline ratings are presented in Table 3-14. The ratings represent the quality of nine different aspects of trout habitat.

Late summer stream flow was assigned an optimal rating in all reaches to account for the 125 cfs minimum instream flow under baseline conditions. Annual stream flow variation was assigned a rating of 3 in all reaches because only small fluctuations (the ratio of the annual peak flow to the annual low flow was between 16 and 39) in flow are expected after the new minimum flow requirement is implemented. Maximum summer temperature and nitrate nitrogen habitat ratings were based on results of water quality modeling for baseline conditions (see Section 3.3, Water Quality). Fish cover was rated low throughout all reaches because of lack of any improvements to the channel under baseline conditions. Eroding stream banks were generally not considered to be a limiting factor and received optimal ratings in all reaches except Reach 9. Submerged aquatic vegetation was rated low in most reaches because of low nutrient inputs and lack of channel structure. Current velocity was rated low in most reaches because of observed high flow velocity problems that would not be improved under baseline conditions. Wetted channel width was rated low in most reaches.

3.5.5.1.3 Baseline Predicted Trout Standing Crop and Biomass. Table 3-15 shows the baseline conditions for habitat quantity, baseline predicted trout standing crop and baseline predicted trout biomass in the impact area of influence. See Section 3.1.2 of this EIS for an explanation of the difference between existing conditions and baseline conditions. Baseline habitat quality attribute ratings were assigned using best professional judgment of the likely effects from providing 125 cfs minimum instream flow and, where available, quantitative data. See Appendix B Section B.3.4.2.1 for a description of this process.

3.5.5.2 Non-Game Fish and Their Habitat

Six non-game fish species were identified from the field surveys in the Provo River, including longnose dace, redside shiner, mountain sucker, mottled sculpin, Utah sucker and leatherside chub (see

Table 3-14
Baseline Habitat Attribute Ratings and Predicted Trout Standing Crop for Provo River

Stream Reach	Baseline Habitat Attribute Ratings[1]									Baseline Predicted Trout Standing Crop[2] (lb/acre)
	X1	X2	X3	X4	X7	X8	X9	X10	X11	
1	4	3	4	1	1	4	1	3	2	**83.6**
2	4	3	4	1	1	4	1	2	2	**66.1**
3	4	3	3	1	1	4	1	2	2	**42.5**
4	4	3	4	1	1	4	1	2	2	**66.1**
5	4	3	4	1	1	4	1	2	2	**66.1**
6	4	3	4	1	1	4	1	2	2	**66.1**
7	4	3	3	1	1	4	2	2	2	**63.3**
8	4	3	3	1	1	4	1	2	2	**42.5**
9	4	3	3	1	1	3	1	2	1	**36.5**

Notes:

[1] Habitat Attribute Ratings (ratings range from 0 [worst] to 4 [best], see Section B.3.4.2.1 in Appendix B for description):

X1-Late summer stream flow
X2-Annual stream flow variation
X3-Maximum summer stream temperature
X4-Nitrate-nitrogen
X7-Fish cover
X8-Eroding stream banks
X9-Submerged aquatic vegetation
X10-Current velocity
X11-Wetted channel width

[2] Predicted trout standing crop is the total weight of trout per unit area of water as calculated by the Binns HQI Model II (see Appendix B, Section B.3.4.2.1 for description).

Table 3-15
Summary of Baseline Habitat Quantity, Predicted Trout Standing Crop and Trout Biomass

Reach	Reach Length (feet)	Average Width (feet)	Surface Area (acres)	Predicted Trout Standing Crop (pounds/acre)	Trout Biomass* (pounds)
1	3,400	63	4.9	84	412
2	5,500	70	8.8	66	581
3	7,510	61	10.5	43	452
4	6,920	78	12.4	66	818
5	4,440	63	6.4	43	275
6	8,720	88	17.6	43	757
7	4,730	83	9.0	63	567
8	4,600	70	7.4	43	318
9	8,460	73	14.2	37	525
Totals	**54,280**		**91.2**		**4,705**

Note:

*Surface area (acres) x predicted trout standing crop (pounds/acre) = trout biomass (pounds) = the total weight of trout in the river reach

Table 3-30 in Section 3.5.5.1 of Chapter 3 in the WCWEP and DRP EIS). The following describes the general occurrence of each non-game fish species based on field surveys during 1993, before establishing 125 cfs instream flow under baseline conditions.

Longnose dace, redside shiner, mountain sucker, and mottled sculpin were the most common non-game fish collected in the Provo River. Leatherside chub is a species with special status. Section 3.5.5.2 in the WCWEP and DRP EIS describes the status of this species and its general habitat requirements. Fourteen leatherside chub were collected in the Provo River.

Baseline estimates of non-game fish standing crop or biomass were not prepared. Length and weight data for non-game fish were collected and are described in the Draft Aquatic Resources Technical Report (CUWCD 1996a). The Binns HQI Model II methodology was developed specifically to estimate trout production and is not appropriate to use with data for other types of fish.

3.5.5.3 Other Aquatic Resources

Other aquatic resources include benthic macroinvertebrates (aquatic insects) and amphibians (frogs, salamanders). Surveys along the Provo River were not conducted for either of these groups except for the spotted frog, which is a Category 1 candidate threatened and endangered species (see Section 3.7, Threatened and Endangered Species). A Category-1 candidate is a species under special consideration to be proposed for listing in the Federal Register under the Endangered Species Act (ESA).

Benthic macroinvertebrates are an important source of food for both game and non-game fish species. The habitat attribute rating for submerged aquatic vegetation is an estimate of the expected density of aquatic macroinvertebrates. This attribute was assigned ratings of 1 for all Provo River stream reaches except for a 2 rating at PR-03 (Reach 7). This indicates that macroinvertebrate abundance is only fair in these streams, with expected aquatic macroinvertebrate densities ranging from 25 to 99 per square foot. A rating of 2 indicates moderate macroinvertebrate density (100 to 249 macroinvertebrates per square foot).

There is no specific information on the presence of amphibians in the Provo River except for the spotted frog. Several amphibian species are reported as year-round residents of the Provo River corridor, including the Woodhouse toad (*Bufo woodhousei*), leopard frog (*Rana pipiens*), boreal chorus frog (*Pseudacris triseriata maculata*), and tiger salamander (*Ambystoma tigrinum*). All amphibian species are associated with pond, marsh and stream riparian areas.

3.5.6 Impact Analysis

3.5.6.1 Significance Criteria

The significance criteria used for the PRRP analysis are the same as described in Section 3.5.6.1 of the WCWEP and DRP EIS.

3.5.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential aquatic resources impacts have been eliminated from further analysis.

3.5.6.3 Proposed Action (Riverine Habitat Restoration)

The following subsections define potential aquatic resources impacts during the construction and operation phases of the Proposed Action.

3.5.6.3.1 Game Fish and Their Habitat

3.5.6.3.1.1 Impacts During Construction. Construction of the Proposed Action would cause short-term soil erosion of the Provo River stream bottom and bank, resulting in increased turbidity during the construction period. This would lead to increased sediment deposition and associated nutrient concentrations in the Provo River in the area immediately downstream from the construction activity, which could potentially impact game fish and their habitat. Typical construction procedures are described in Section 1.7.3.1 of this EIS. The use of cofferdams, sediment detention ponds, constructing during dry or low-flow periods, and a sequential construction schedule would likely limit the extent of turbidity impacts to the area of the reach where construction is underway. SOPs for Aquatic resources, revegetation and erosion would be implemented to minimize potential adverse impacts caused by turbidity and sediment deposition during construction (see Section 1.12.9 of Chapter 1 of the WCWEP and DRP EIS and Section 1.11.7 of Chapter 1 of the PRRP EIS). As determined by the soil analysis described in Section 3.8, Soil Resources, these SOPs would control erosion near stream corridors and minimize the risk of siltation of stream channels during construction. Therefore, the introduction of sediments into the Provo River from construction would be minimal and probably not measurably different than baseline conditions. Similarly, associated increases in nutrient concentrations would be so small compared to baseline conditions that they likely could not be measured, and there would be no significant impacts on game fish and their habitat.

Temporary impacts on game-fish spawning areas would occur during construction of the Proposed Action. These impacts would occur during construction when spawning areas would be lost as water is diverted into a newly-constructed reach and the former river channel becomes dry. The impact would be temporary because the newly-constructed reach would replace the spawning habitat lost in the former reach. Loss of game-fish species could occur if developing eggs were present in the gravel during construction, and if fish were stranded in the reach as it is dewatered. However, the phased construction of the Proposed Action will reduce the amount of spawning area that is removed at any one time. In addition, SOPs for aquatic resources will avoid impacts on game-fish spawning areas by reducing access by resident fish to areas being constructed and moving any stranded fish from dewatered areas. Overall, there would be no significant impacts on game-fish spawning areas because there would be no permanent removal of any spawning areas.

Water temperature would temporarily increase during construction of the Proposed Action because of removal of riparian vegetation that now shades portions of the existing channel. The estimated increase in maximum summer stream temperature ranges from 1.2°F in Reach 5 to 6.2°F in Reach 8. It would take an estimated 15 to 30 years after construction for revegetated areas to reach levels comparable to baseline conditions. These temperature increases would not be significant based on the habitat attribute criteria for maximum summer stream temperature. For all reaches, the estimated increase in temperature was within the range of an optimal rating for maximum summer stream temperature, according to the methodology used for the Binns HQI Model II. Therefore, there would be no short- or long-term impacts on game fish and their habitat.

3.5.6.3.1.2 Impacts After Construction. After construction the Proposed Action would result in changes in physical habitat characteristics, habitat quality attributes, and predicted trout standing crop in the Provo River. The following are descriptions of these changes.

Physical Habitat Characteristics. Table 3-16 shows the projected changes from baseline conditions in Provo River physical habitat characteristics under the Proposed Action based on results described in an engineering analysis of alternatives for the Provo River Restoration Project (CUWCD 1994a). The length of the Provo River would increase by 10,540 feet while the surface area of aquatic habitat would increase by 15.6 acres under the Proposed Action. This would have a positive impact on game-fish and their habitat in the impact area of influence.

Side channels and ponds would be developed under the Proposed Action on both sides of the new river alignment in Reaches 2 through 9. No side channels would be constructed in Reach 1. About 56,700 feet (10.7 miles) of side channels would be developed (see Section 1.3.2 in this EIS). The side channels and ponds would provide additional rearing habitat for juvenile game fish and habitat for non-game species that prefer streams with lower velocities. The ponds would be constructed in the side channels.

The changes in physical habitat characteristics of the Provo River described in this section for the Proposed Action generally would result in a positive impact on habitat for game fish and aquatic resources. The proposed changes would provide a stable, functioning stream that would allow development of optimal habitat conditions over time. This statement is based on results of case studies in stream restoration for Bear Valley Creek in central Idaho and the East Fork Sevier River in south central Utah. A more detailed discussion of these results is contained in the Appendix to the

Table 3-16
Summary of Changes in Provo River Physical Habitat Characteristics From Baseline Conditions Under the Proposed Action

	Reach Length			Stream Surface Area		
Reach	Baseline (feet)	Proposed Action (feet)	Change From Baseline (feet)	Baseline (acres)	Proposed Action (acres)	Change From Baseline (acres)
1	3,400	3,400	0.0	4.9	4.9	0.0
2	5,500	6,500	1,000	8.8	10.9	2.1
3	7,510	8,390	880	10.5	13.9	3.4
4	6,920	7,900	980	12.4	13.1	0.7
5	4,440	5,770	1,330	6.4	9.4	3.0
6	8,720	10,770	2,050	17.6	17.8	0.2
7	4,730	5,440	710	9.0	8.9	-0.1
8	4,600	6,220	1,620	7.4	10.4	3.0
9	8,460	10,430	1,970	14.2	17.5	3.3
Totals	**54,280**	**64,820**	**10,540**	**91.2**	**106.8**	**15.6**

Note:
Data from CUWCD (1994a)

Draft Aquatic Resources Technical Report (CUWCD 1996a).

Although the general trend of the case study physical habitat monitoring showed improved conditions over time, there was considerable year-to-year variability. Following construction, the recovery process of the case study streams to stable, improved habitat conditions included both increases and decreases in one or more attributes. It was not a smooth, uniform process. In the case of Bear Valley Creek, effects from a prolonged drought likely contributed to the up and down variability in habitat attributes. This type of variability in development of physical habitat characteristics following construction probably would occur in the Provo River under the Proposed Action. As with the case study streams, the important consideration is that the general trend over time is toward improved conditions and overall stability of the physical habitat that is developed over time.

Habitat Quality Attributes. In general, analysis of the Proposed Action resulted in optimal, or nearly optimal, ratings for most habitat attributes compared to baseline ratings. Late summer stream flow was rated optimal under baseline conditions and did not change as a result of the Proposed Action. In addition, the attribute ratings for nitrate-nitrogen and eroding stream banks were unchanged from baseline conditions.

Maximum summer stream temperature, fish cover, and submerged aquatic vegetation attributes were rated optimal or nearly optimal. This was based on water quality modeling of the Proposed Action (see Section 3.3, Water Quality) and monitoring results from case studies that documented improvements in stream temperature, fish cover and submerged aquatic vegetation over time.

Current velocity was rated optimum in all reaches as a result of design parameters included under the Proposed Action, average monthly flows reported in the water resources analysis (see Section 3.2, Water Resources), and typical channel cross-sectional area. This rating also was supported by results from the Bear Valley Creek restoration case study, which showed lower current velocities throughout the restored reach.

Wetted channel width was rated 3 in all reaches, except Reach 1, as a result of design parameters included in the Proposed Action. Reach 1 was unchanged from baseline conditions.

Predicted Trout Standing Crop. The habitat quality attribute ratings described in the previous paragraphs would lead to improved aquatic habitat quality and result in an increase in the predicted trout standing crop. Table 3-17 shows predicted trout standing crop and biomass in Reaches 1 through 9 under the Proposed Action, and changes in these estimates from baseline conditions. All reaches would experience an increase in predicted trout standing crop and biomass. The predicted increases do not include increases from additional habitat provided by development of side channels and ponds, which was not quantified, but would be an overall positive impact.

The overall increase in predicted trout standing crop under the Proposed Action ranges from zero to 263.7 pounds/acre (see Table 3-17). Predicted trout biomass would increase by 25,754 pounds (491 percent) under the Proposed Action. This increase in predicted trout standing crop and trout biomass over baseline conditions would be a positive impact resulting from the Proposed Action. It would take an estimated 15 to 20 years to reach the full potential of trout production as a result of the improvements in habitat quality (see Section 3.5.5.3.1.2 of the WCWEP and DRP EIS for the basis of this estimate).

The increase in predicted trout standing crop under the Proposed Action is supported by monitoring results for the stream restoration case studies. At Bear Valley Creek in central Idaho, results of fish density monitoring varied considerably over time despite a general upward trend. This project is located on upper Bear Valley Creek, Idaho, in the headwaters region of the Middle Fork of the Salmon River. General hydrologic conditions of the drainage basin are similar to those in the Provo River basin. Following construction, annual monitoring surveys were conducted from 1987 through 1990, and again in 1993. The system had stabilized over the period of the monitoring. One trend that was evident in Bear Valley Creek post-restoration monitoring was increased population density over time for young-of-the-year, juvenile and resident trout species. The restored reach also had greater relative increases in fish population density than control areas upstream and downstream of the restored reach. The species monitored in Bear Valley Creek included steelhead/rainbow trout

Table 3-17
Summary of Impacts on Trout Standing Crop and Biomass Under the Proposed Action (Riverine Habitat Restoration)

	Predicted Trout Standing Crop[1]				Predicted Trout Biomass[2,3]			
Reach	Baseline (lb/acre)	Proposed Action (lb/acre)	Change from Baseline (lb/acre)	Percent Change from Baseline (%)	Baseline (pounds)	Proposed Action (pounds)	Change from Baseline (pounds)	Percent Change from Baseline (%)
1	84	84	0	0	410	410	0	0
2	66	300	234	355	582	3272	2690	462
3	43	300	257	598	446	4173	3727	836
4	66	300	234	355	820	3933	3113	380
5	43	300	257	598	272	2822	2550	938
6	43	300	257	598	748	5344	4596	614
7	63	300	237	376	570	2672	2102	369
8	43	300	257	598	315	3122	2807	891
9	37	300	263	711	518	5254	4736	914
Totals	**n/a[4]**	**n/a**	**n/a**	**n/a**	**4,681**	**31,002**	**26,321**	**562**

Notes:

[1] Predicted Trout Standing Crop is the modeled living mass of trout per unit area of water.

[2] Predicted Trout Biomass is the modeled living mass of trout in the stream reach.

[3] Predicted trout biomass was determined by multiplying the surface area (acres) of habitat created in a reach by the predicted trout standing crop (pounds/acre) in that reach.

[4] n/a = not applicable

hybrids, cutthroat trout, brook trout and mountain whitefish.

The East Fork of the Sevier River is located in Garfield County in south central Utah. The river originates in the forested headwaters of the Dixie National Forest located north of Bryce Canyon National Park, and flows south to its confluence with the Sevier River at Junction, Utah. The mean summer daily flow is 21.9 cfs and the mean annual daily flow is 25.8 cfs. At the East Fork Sevier River, available fish monitoring data only covered one year after restoration. Results for brown, rainbow and cutthroat trout generally showed slight declines in population densities following restoration compared to pre-restoration. Although the information only covers one year, it is an important illustration of the anticipated level of effects on resident fish in the Provo River following construction of the Proposed Action.

Variability in fish standing crop and biomass also would be expected in the Provo River following development of a new river channel under the Proposed Action. The variability would likely be relatively high during the first few years and gradually decrease as physical conditions stabilize and habitat features develop. The stream restoration case studies showed that improvements in habitat result in improvement in fish populations, but the improvement takes a number of years and varies considerably year-to-year.

3.5.6.3.2 Non-Game Fish and Their Habitat

3.5.6.3.2.1 Impacts During Construction. Potential impacts of construction on non-game fish and their habitat would be the same as described in Section 3.5.6.3.1.1 for game fish.

3.5.6.3.2.2 Impacts After Construction. Potential impacts after construction of the Proposed Action would include changes in physical habitat characteristics, habitat quality attributes, and potential changes in standing crop of non-game fish. The following are descriptions of these changes:

Physical Habitat Characteristics. The Proposed Action would result in increased aquatic habitat surface area and channel complexity within the main channel of the Provo River. Construction of a riffle-pool channel sequence would produce a similar level of benefit to most non-game fish species as described for game fish species. Habitat quality may decrease for some non-game species, such as the leatherside chub, which prefer relatively warmer, slower-moving water compared to game fish. Most of this decrease would be caused by the change from existing conditions to the provision of 125 cfs minimum instream flow under baseline conditions for this EIS. The increase in aquatic habitat surface area and complexity over baseline conditions would be a positive impact on non-game fish and their habitat.

Development of side channels and ponds under the Proposed Action would benefit non-game species, which prefer slower current velocities, relatively warmer temperatures and increased habitat complexity. Development of these features would have a positive impact on non-game fish and their habitat.

Habitat Quality Attributes. Most of the ratings for habitat quality attributes would improve for game fish and their habitat compared to baseline conditions. In general, the improvements in habitat conditions for game fish associated with the Proposed Action would not result in a decrease in habitat quality for non-game fish. Most of the non-game fish found in the Provo River are widely distributed throughout streams in the Intermountain West and co-exist with game fish throughout their range. Several changes in habitat attributes from baseline conditions, reflecting optimal conditions for game fish, would either benefit or have no effect on non-game fish. These are described below.

The increase in maximum summer stream temperature described for game fish species would have no effect on non-game fish. In general, most non-game fish found in the Provo River tolerate a higher range of water temperatures compared to game fish.

An increase in fish cover (X7 in the Baseline Habitat Quality Attribute Ratings) would benefit non-game fish. Fish cover includes places of refuge such as instream structures or overhanging, undercut banks. Under the Proposed Action, construction of side channels would provide additional cover that would benefit non-game species by providing additional habitat complexity.

An increase in submerged aquatic vegetation (X9) would increase macroinvertebrate density, a food source that would benefit non-game fish.

A reduction in baseline current velocity (X10) would benefit non-game fish. The stream gradient and riffle-pool sequence that would be constructed under the Proposed Action would reduce baseline current velocities.

Predicted Standing Crop. The Binns Habitat Quality Index (HQI) Model II was developed to predict standing crop of trout populations and is not appropriate for quantitative estimations of potential changes in the standing crop of non-game fish. However, it is likely that improvements in stream habitat to conditions that support an increase in the predicted trout standing crop would also result in an increase in the standing crop of non-game fish species.

3.5.6.3.3 Other Aquatic Resources

3.5.6.3.3.1 Impacts During Construction. The Proposed Action would not result in any significant impacts during construction to other aquatic resources for the same reasons described in Section 3.5.6.3.1.1 for game fish species and their habitat.

3.5.6.3.3.2 Impacts After Construction. Potential impacts after construction of the Proposed Action would be the same as described in Section 3.5.6.3.2.2 for non-game fish and their habitat. Overall, improved physical characteristics of the Provo River and improved habitat quality attributes would result in a positive impact on other aquatic resources.

3.5.6.3.4 Impact Summary. There would be a short-term loss of available habitat and a potential degradation of water quality during construction. However, the potential water quality-related impacts (increased sediment deposition, increased nutrient concentrations, and an increase in maximum summer stream temperatures until vegetation is re-established) would not be significant or adverse.

Improvements in aquatic resources habitat from the channel and side-channel development features of the Proposed Action would result in positive impacts. Trout biomass would increase over baseline conditions. Total trout biomass over all reaches would increase an estimated 25,754 pounds (or 491 percent) over baseline conditions. It would take about 15 to 20 years for trout production to reach the full potential predicted under the Proposed Action. The increase in predicted trout standing crop and biomass would be a positive impact of the Proposed Action.

A total of 106.8 acres of aquatic habitat surface area would be developed within the restored, natural river channel under the Proposed Action compared to 91.2 acres under baseline conditions, resulting in an increase of 15.6 acres (or 17 percent) in aquatic habitat surface area compared to baseline conditions. The Proposed Action would also include side channels and ponds adjacent to the main river channel, which would provide additional aquatic habitat surface area outside the main river channel. This would result in an increase in the diversity of aquatic habitat types as well as surface area of habitat types, which would be a positive impact of the Proposed Action.

3.5.6.4 Existing Channel Modification Alternative

3.5.6.4.1 Game Fish and Their Habitat

3.5.6.4.1.1 Impacts During Construction. Construction of the Existing Channel Modification Alternative may cause short-term soil erosion during construction. This would lead to increased sediment deposition and associated increased nutrient concentrations in the Provo River which may cause a short-term impact on game fish and their habitat. However, the soil analysis (Section 3.8, Soil Resources) concludes that the construction activities only would cause negligible amounts of soil to enter the Provo River. Therefore, potential impacts on game fish spawning areas from sedimentation and increases in nutrient concentrations would not be significant.

Water temperatures would increase slightly under the Existing Channel Modification Alternative, generally the result of removing existing riparian vegetation that shades portions of the existing channel. It would take an estimated 15 to 30 years after construction for revegetated areas to reach shading levels comparable to baseline conditions. The estimated increase in maximum summer stream temperature ranges from no increase in Reaches 4 and 5 to a 5.4°F increase in Reach 8. Based on the habitat attribute criteria for maximum summer stream temperature these increases would still result in temperature-related ratings of 4 (optimal) for all stream reaches. No temperature-related impacts on game fish and their habitat would result.

3.5.6.4.1.2 Impacts After Construction. After construction, this alternative would result in changes in physical habitat characteristics, habitat quality attributes and predicted trout standing crop in the Provo River. Following are descriptions of these changes.

Physical Habitat Characteristics. Table 3-18 shows the reach length and surface area that would be developed under the Existing Channel Modification Alternative compared to baseline conditions. This alternative would not change the length of the Provo River. The surface area of aquatic habitat under the Existing Channel Modification Alternative would be 73.3 acres compared to 91.2 acres under baseline conditions. This would be a decrease of 17.9 acres (or 20 percent) in aquatic habitat surface area compared to baseline conditions. This is a result of a low flow channel configuration that would be relatively narrower and deeper than under baseline conditions, thus reducing the overall surface area. The low flow channel would provide greater water depth at low flow compared to baseline conditions, resulting in improved aquatic habitat even though the surface area is less than baseline conditions. There would be no significant impacts on game fish or their habitat as a result of the loss of surface area from the development of a low flow channel under this alternative.

Habitat Quality Attributes. In general, most habitat attribute ratings would increase compared to baseline ratings. No changes were made in the baseline ratings in Reach 1 because the Existing Channel Modification Alternative does not include any improvements in that reach. The habitat attribute for maximum summer stream temperature is rated 4 (optimal) in all reaches, based on the water quality modeling results by reach and habitat attribute criteria. Nitrate-nitrogen levels would be unchanged from baseline conditions for the same reasons described in Section 3.5.6.3.1.2 for the Proposed Action.

The habitat attribute ratings for fish cover, submerged aquatic vegetation, current velocity and wetted channel width were generally scored one to two ratings higher than the corresponding baseline ratings (i.e., they were rated 2 or 3 versus 1 under

Table 3-18
Summary of Changes in Provo River Physical Habitat Characteristics from Baseline Conditions Under the Existing Channel Modification Alternative

	Reach Length			Stream Surface Area		
Reach	**Baseline (feet)**	**Existing Channel Modification Alternative (feet)**	**Change From Baseline (feet)**	**Baseline (acres)**	**Existing Channel Modification Alternative (acres)**	**Change From Baseline (acres)**
1	3,400	3,400	0.0	4.9	4.9	0.0
2	5,500	5,500	0.0	8.8	8.3	-0.5
3	7,510	7,510	0.0	10.5	11.4	0.9
4	6,920	6,920	0.0	12.4	10.3	-2.1
5	4,440	4,440	0.0	6.4	5.1	-1.3
6	8,720	8,720	0.0	17.6	10.0	-7.6
7	4,730	4,730	0.0	9.0	5.4	-3.6
8	4,600	4,600	0.0	7.4	5.3	-2.1
9	8,460	8,460	0.0	14.2	12.6	-1.6
Totals	**54,280**	**54,280**	**0.0**	**91.2**	**73.3**	**-17.9**

Note:
Data from CUWCD (1994a)

baseline). These ratings were based on predicted improvements in the related habitat attributes that would result from physical improvements to channel morphology and instream structure under the Existing Channel Modification Alternative.

Predicted Trout Standing Crop. The habitat quality attribute ratings described in this section would lead to improved aquatic habitat quality and result in an increase in the predicted trout standing crop. Table 3-19 shows predicted trout standing crop and biomass in Reaches 1 through 9 under the Existing Channel Modification Alternative and changes in these estimates from baseline conditions.

All reaches would experience an increase in predicted trout standing crop and biomass. The increase in predicted trout standing crop under the Existing Channel Modification Alternative ranges from zero to 149.8 pounds per acre (see Table 3-19). Overall predicted trout biomass would increase by 7,906.6 pounds (or 151 percent) compared to baseline conditions. This increase in predicted trout standing crop and trout biomass over baseline conditions is a positive impact resulting from the Existing Channel Modification Alternative. It would take about 15 to 20 years for trout production to reach the full potential as a result of improvements in habitat quality (see Section 3.6.5.3.1.2 of the WCWEP and DRP EIS for the basis of this estimate).

3.5.6.4.2 Non-Game Fish and Their Habitat

3.5.6.4.2.1 Impacts During Construction. Potential impacts of construction on non-game fish and their habitat are the same as described in Section 3.5.6.4.1.1 for game fish.

3.5.6.4.2.2 Impacts After Construction. Potential impacts after construction of the Existing Channel Modification alternative include changes in physical habitat characteristics, habitat quality attributes, and potential changes in standing crop of non game fish. Following are descriptions of these changes.

Physical Habitat Characteristics. The physical habitat characteristics of the Existing Channel Modification Alternative are described in Section 3.5.6.4.1.2. An increase in channel complexity and construction of a step-pool channel sequence would result in benefits to non-game fish species compared to baseline conditions. Side channels would not be constructed under the Existing Channel Modification alternative.

Habitat Quality Attributes. The predicted changes in habitat attribute ratings under the Existing Channel Modification Alternative were described in Section 3.5.6.4.1.2. As previously stated, most of the ratings increase compared to baseline conditions. In general, the improvements in habitat conditions for game fish associated with this alternative would also result in an increase in habitat quality for non-game fish.

Predicted Standing Crop. The Binns HQI Model II was developed to predict standing crop of trout populations and is not appropriate for quantitative estimates of potential changes in non-game fish standing crop. However, it is likely that improvements in stream habitat under the Existing Channel Modification Alternative would result in an increase in the standing crop of non-game fish species.

3.5.6.4.3 Other Aquatic Resources

3.5.6.4.3.1 Impacts During Construction. Construction of the Existing Channel Modification Alternative would not result in any significant impacts to other aquatic resources for the same reasons described in Section 3.5.6.4.1.1 for game fish species and their habitat.

3.5.6.4.3.2 Impacts After Construction. Potential impacts after construction of the Existing Channel Modification Alternative would be the same as described in Section 3.5.6.4.2.2 for non-game fish and their habitat. Overall, improved physical characteristics of the Provo River and improved habitat quality attributes would have a positive impact on other aquatic resources.

3.5.6.4.4 Impact Summary. There would be a short-term loss of available habitat and potential water quality degradation during construction. Water quality-related impacts would include increased sediment deposition, increased nutrient concentrations, and an increase in maximum summer stream temperature. However, these impacts would not be significant.

The total length of the Provo River would not change under this alternative. Aquatic habitat surface area would be 73.3 acres (see Table 3-18)

Table 3-19

Summary of Impacts on Trout Standing Crop and Biomass Under the Existing Channel Modification Alternative

	Predicted Trout Standing Crop[1]				Predicted Trout Biomass[2,3]			
Reach	**Baseline (lb/acre)**	**Existing Channel Mod. Alt. (lb/acre)**	**Change from Baseline (lb/acre)**	**Percent Change from Baseline (%)**	**Baseline (pounds)**	**Existing Channel Mod. Alt. (pounds)**	**Change from Baseline (pounds)**	**Percent Change from Baseline (%)**
1	84	84	0	0	410	410	0	0
2	66	186	120	182	582	1546	964	166
3	43	186	143	333	446	2123	1677	376
4	66	186	120	182	820	1918	1098	134
5	43	119	76	177	272	605	333	122
6	43	186	143	333	748	1863	1115	149
7	63	186	123	195	570	1006	436	76
8	43	119	76	177	315	629	314	100
9	37	186	149	403	518	2347	1829	316
Totals	**n/a[4]**	**n/a**	**n/a**	**n/a**	**4,681**	**12,447**	**7,766**	**166**

Notes:

[1] Predicted Trout Standing Crop is the modeled living mass of trout per unit area of water.

[2] Predicted Trout Biomass is the modeled living mass of trout in the stream reach.

[3] Predicted trout biomass was determined by multiplying the surface area (acres) of habitat created in a reach by the predicted trout standing crop (pounds/acre) in that reach.

[4] n/a = not applicable

compared to 91.2 acres under baseline conditions. This would be a decrease of 17.9 acres (or 20 percent) in surface area compared to baseline conditions. No side channels would be developed under this alternative.

Operation of this alternative would have positive impacts on game fish and their habitat. Predicted trout standing crop would increase over baseline conditions. The increase would range from zero to 149.8 pounds per acre compared to baseline conditions. Trout biomass would increase over baseline conditions by 7,906.6 pounds (or 151 percent). This would be a positive impact of this alternative.

Positive impacts on non-game fish and their habitat and other aquatic resources would generally be the same as described for game fish and their habitat in Section 3.5.6.4.1.

3.5.6.5 Instream Structures Alternative

3.5.6.5.1 Game Fish and Their Habitat

3.5.6.5.1.1 Impacts During Construction. Construction of the this alternative has the potential to cause minor and temporary increases in soil erosion. This would lead to increased sediment deposition and associated nutrient concentrations in the Provo River that could potentially impact game fish and their habitat. However, the soil analysis in Section 3.8 (Soil Resources) concluded that construction activities would cause only negligible amounts of soil to enter the Provo River. Therefore, sedimentation is not expected to have any impacts on game fish spawning areas, and increases in nutrient concentrations would be insignificant.

The water quality analysis included an evaluation of potential water temperature impacts under the Instream Structures Alternative. There would be no change from baseline conditions because little riparian vegetation clearing would be required. There also would be no temperature-related impacts on game fish and their habitat.

3.5.6.5.1.2 Impacts After Construction. After construction, this alternative would result in changes in physical habitat characteristics, habitat quality attributes and predicted trout standing crop in the Provo River. Following are descriptions of these changes.

Physical Habitat Characteristics. Physical habitat characteristics of the river channel would generally not change under this alternative. Reach length and surface area would be the same as shown on Table 3-15 for baseline conditions. Side channels would not be constructed under the Instream Structures Alternative.

The addition of root wads or boulders to the Provo River channel would increase habitat complexity by breaking up the flow and creating pockets of relatively lower velocity. This change would benefit game fish species by providing holding or refuge areas in the channel but outside the main current.

Habitat Attributes. In general, most habitat attribute ratings increase compared to baseline conditions. No changes in baseline ratings were made in Reach 1 because this alternative does not include any improvements to that reach. The change in ratings is typically only to the next higher rating because this alternative only involves placing instream structures (log, boulders, and root wads) in the Provo River, with no other channel or habitat improvements.

The habitat attribute ratings for nitrate nitrogen and maximum summer stream temperature would not change from baseline conditions.

Predicted Trout Standing Crop. The habitat quality attribute ratings described above would lead to improved aquatic habitat quality and result in an increase in the predicted trout standing crop of. Table 3-20 shows predicted trout standing crop and biomass in Reaches 1 through 9 under the Instream Structures Alternative and changes in these estimates from baseline conditions.

All reaches except Reach 1 would experience an increase in predicted trout standing crop and biomass. The increase in predicted trout standing crop under the Instream Structures Alternative ranges from zero to 45.4 pounds per acre (see Table 3-19). Overall predicted trout biomass would increase by 3,077.4 pounds (or 59 percent) compared to baseline conditions. This increase in predicted trout standing crop and biomass over baseline conditions is a positive impact resulting from the Instream Structures Alternative. It would take an estimated 15 to 20 years to reach the full

Table 3-20
Summary of Impacts on Trout Standing Crop and Biomass Under the Instream Structures Alternative

Reach	Predicted Trout Standing Crop[1]				Predicted Trout Biomass[2,3]			
	Baseline (lb/acre)	Instream Structures Alternative (lb/acre)	Change from Baseline (lb/acre)	Percent Change from Baseline (%)	Baseline (pounds)	Instream Structures Alternative (pounds)	Change from Baseline (pounds)	Percent Change from Baseline (%)
1	84	84	-0-	-0-	410	410	-0-	-0-
2	66	71	5	8	582	628	46	8
3	43	112	69	160	446	1173	727	163
4	66	71	5	8	820	881	61	7
5	43	71	28	65	272	457	185	68
6	43	71	28	65	748	1253	505	68
7	63	71	8	13	570	641	71	12
8	43	71	28	65	315	526	211	67
9	37	68	31	84	518	960	442	85
Totals	**n/a[4]**	**n/a**	**n/a**	**n/a**	**4,681**	**6,929**	**2,248**	**48**

Notes:

[1] Predicted Trout Standing Crop is the modeled living mass of trout per unit area of water.

[2] Predicted Trout Biomass is the modeled living mass of trout in the stream reach.

[3] Predicted trout biomass was determined by multiplying the surface area (acres) of habitat created in a reach by the predicted trout standing crop (pounds/acre) in that reach.

[4] n/a = not applicable

potential of trout production as a result of the improvements in habitat quality (see Section 3.5.5.3.1.2 of the WCWEP and DRP EIS for the basis of this estimate).

3.5.6.5.2 Non-Game Fish and Their Habitat

*3.5.6.5.2.1 **Impacts During Construction.*** Potential impacts of construction on non-game fish and their habitat are the same as described in Section 3.5.6.5.1.1 for game fish.

*3.5.6.5.2.2 **Impacts After Construction.*** Potential impacts after construction of the Instream Structures Alternative include changes in physical habitat characteristics, habitat quality attributes, and potential changes in standing crop of non-game fish. Following are descriptions of potential impacts after construction of this alternative.

Physical Habitat Characteristics. The physical habitat characteristics of the Instream Structures Alternative are described in Section 3.5.6.5.1.2. An increase in channel complexity from the addition of root wads or boulders would result in benefits to non-game fish species compared to baseline conditions.

Habitat Quality Attributes. The predicted changes in habitat attribute ratings under this alternative are described in Section 3.5.6.5.1.2. As previously stated, most of the ratings increase compared to baseline conditions. In general, the improvements in habitat conditions for game fish associated with this alternative would not result in a decrease in habitat quality for non-game fish.

Predicted Standing Crop. The Binns HQI Model II was developed to predict standing crop of trout populations, but is not appropriate for quantitative estimates of potential changes in non-game fish standing crop. However, it is likely that improvements in stream habitat under this alternative would result in an increase in the standing crop of non-game fish species.

3.5.6.5.3 Other Aquatic Resources

*3.5.6.5.3.1 **Impacts During Construction.*** Construction of this alternative would not result in any impacts to other aquatic resources for the same reasons described in Section 3.5.6.5.1.1 for game fish species and their habitat.

*3.5.6.5.3.2 **Impacts After Construction.*** Potential impacts after construction of this alternative would be the same as described in Section 3.5.6.5.2.2 for non-game fish and their habitat. Overall, improved physical characteristics of the Provo River and improved habitat quality attributes would have a positive impact on other aquatic resources.

3.5.6.5.4 Impact Summary. There would be short-term, potential water quality degradation during construction, but it would not be significant to game fish species and their habitat.

Predicted trout standing crop would generally increase compared to baseline conditions. The predicted increase ranges from zero to 45.4 pounds per acre. Reach 1 would be unchanged from baseline conditions. The total predicted trout biomass over all reaches increased by 3,077.4 pounds (or 59 percent) over baseline conditions.

Total stream length, width and aquatic habitat surface area would not change from baseline conditions. No side channels would be developed under this alternative.

Positive impacts on non-game fish and other aquatic resources would also generally be the same as described for game fish and their habitat in Section 3.5.6.5.1.

3.5.6.6 No Action Alternative

The No Action Alternative would result in a continuation of the baseline aquatic resources conditions described in Section 3.5.5. Routine dike and diversion maintenance would continue. Dike and diversion maintenance that occurred within the Provo River channel would result in localized sediment deposition and disruption or loss of aquatic habitat.

3.6 Wildlife Resources

3.6.1 Introduction

The wildlife resources analysis addresses potential impacts on wildlife species and their habitat from construction and maintenance of the Proposed Action and alternatives. The information and analysis documented in this section was summarized from the Draft Wildlife Resources Technical Report

(CUWCD 1996g). Readers also are directed to Section 3.4 Wetlands, in the PRRP EIS, for a detailed description of wildlife habitat wetland types. Potential impacts on listed and candidate threatened or endangered wildlife species are described in Section 3.7 of this EIS (Threatened, Endangered and Candidate Species), and are not considered under wildlife resources. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.5.

The following wildlife resources impact topics are addressed in this impact analysis:

- Game species (i.e., deer, fur-bearing mammals, waterfowl, upland game birds) and their habitat
- Non-game species (i.e., non-domestic small mammals, birds, reptiles, amphibians) and their habitat

3.6.2 Issues Eliminated From Further Analysis

None of the wildlife resources issues raised during scoping and defined in Section 3.6.3 have been eliminated from further analysis.

3.6.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What are the potential impacts of project construction on wildlife and their habitat?
- What are the effects of pedestrian access on wildlife and their habitat?
- What are the impacts of potential redistribution of wildlife habitat and wildlife on local property owners?

3.6.4 Description of Impact Area of Influence

The wildlife resources impact area of influence (See Map A-5 in pocket at the back of EIS) consists of the zone of riparian and upland vegetation along the Provo River from the outlet of Jordanelle Reservoir downstream to Deer Creek Reservoir. It includes the following areas: lands within the boundary of the 100-year floodplain for the Proposed Action; lands outside the 100-year floodplain that would be acquired for access, construction or as flood easement; and lands within the existing channel and floodplain that would be outside the new 100-year floodplain or acquisition areas. The area generally averages about 1,000-feet wide over approximately 10 miles of river channel. The impact area of influence is referred to as the Provo River corridor in the following discussion of the affected environment and the wildlife resources impact analysis.

The Provo River was divided into nine stream reaches for purposes of describing baseline conditions and documenting potential impacts under the Proposed Action and alternatives (see Map 3-1 in Section 3.1.1.1). It should be noted that no construction activities are planned in Reach 1 under the Proposed Action and alternatives, so no impacts are expected in this reach.

3.6.5 Affected Environment (Baseline Conditions)

3.6.5.1 Game Species and Their Habitats

Game species within the Provo River corridor include a number of mammals as well as waterfowl and upland bird species. Game species habitats include riparian woodlands and non-riparian wetlands. Non-riparian wetland habitats include wet and moist meadows, emergent marsh, and shrub wetlands.

3.6.5.1.1 Mammals. Mule deer are common and utilize riparian woodland and non-riparian wetland habitats. The riparian woodlands provide shade, cover, browsing habitat and fawning sites (in June through July) for mule deer. The non-riparian wetlands and areas supporting grasses and grass-like plants provide forage and migration corridors for mule deer.

Other game species, including moose, bear, elk and mountain lion, have ranges that include the Provo River corridor. Moose, which browse and find cover in riparian woodlands, have been reported in the riparian woodland habitats in certain reaches of the Provo River corridor, but are not common. Small fur-bearing mammals also are present in these areas. Bear, elk and mountain lion are relatively uncommon in the Provo River corridor because of vehicle traffic and the generally disturbed nature of the area. Mountain lion and bear are more likely to utilize the Provo River corridor riparian woodland habitats during dry years when they come down from higher-elevation habitats seeking water, forage and cover.

3.6.5.1.2 Birds. Game birds include waterfowl and upland game species. Waterfowl, which are seasonal and permanent residents of the Provo River corridor, frequent riparian woodlands and marshes and ponds in the non-riparian wetland habitat category, using them for nesting, cover and feeding.

Waterfowl also use flooded fields on a seasonal basis for resting and feeding. These fields are part of the upland habitat type that includes irrigated and non-irrigated pasture land as well as native upland vegetation such as cheatgrass and sagebrush. Most native upland habitats have been removed from the river ecosystem and converted to agricultural production. Remaining native upland vegetation is mostly found within Reach 6.

Upland game birds, including turkey, grouse, partridge, quail, pheasant and chukar, are year-round residents of upland habitats in the Provo River corridor. They frequent both riparian woodland and non-riparian wetland habitat types such as woodland edges, irrigated pasture and marsh edges for nesting, cover, and feeding.

3.6.5.2 Non-Game Species and Their Habitats

3.6.5.2.1 Mammals. Non-game mammals include a number of fur-bearing species, such as foxes, coyote, beaver, mink, weasel, raccoon and bobcat. Riparian woodland is the primary habitat type of these species, but foxes and coyotes also frequent open, non-riparian wetland areas and wooded areas. Other mammals that frequent the Provo River corridor on a year-round basis are shrews, voles, mice, bats, rabbits, squirrels, skunk and porcupine, which use riparian woodlands for cover and foraging. Many also frequent wet areas associated with non-riparian wetlands as well as upland areas.

3.6.5.2.2 Birds. A diverse group of non-game bird species frequent the Provo River corridor, including raptors, migratory waterfowl and wading birds, gulls, woodpeckers, owls, flycatchers, swallows and passerine (perching) species. Passerines, piciformes (flickers, woodpeckers) and other small birds use the riparian habitat associated with the river on a year-round and seasonal basis.

Cottonwood trees provide nesting structures for many bird species associated with the riparian woodland habitat. Mature and decaying cottonwoods provide a platform to build secure nests and material for cavity nesters, which include flickers and woodpeckers. Raptors also use the mature cottonwoods. Hawks nest and roost in the mature cottonwoods and forage from perches in these trees. Eagles also forage from perches in the cottonwood trees.

3.6.5.2.3 Reptiles and Amphibians. Reptile and amphibian species present in the Provo River corridor include several species of lizards and skinks, eight species of snakes, three species of frogs and one species of salamander. The Draft Wildlife Resources Technical Report (CUWCD 1996g) includes a listing of reptile and amphibian species. Lizards prey on insects and are found on open ground, sagebrush and rocky areas. Snakes feed on small mammals, insects and spiders and are found in upland habitats and edge areas of riparian woodlands and non-riparian wetlands in the Provo River corridor. Frogs and toads feed on insects and worms and frequent grasslands, brushy areas, marshes and ponds in the Provo River corridor. Salamanders feed on insects and are typically found in ponds, marshes, streams and other wet areas of the riparian woodland habitat.

3.6.6 Impact Analysis

3.6.6.1 Significance Criteria

The significance criteria established for wildlife resources under the Proposed Action and alternatives are the same as described in Section 3.6.6.1 of the WCWEP and DRP EIS, except that native upland habitat is scarce in the Provo River corridor, and any loss is considered significant.

Significant potential impacts on game and non-game wildlife and their habitat under the Proposed Action and alternatives are the same as described in Section 3.6.6.1 of the WCWEP and DRP EIS. The only exception is that potential impacts would include activities that remove any existing non-riparian wetland habitat or native upland habitat in addition to existing riparian habitat along the Provo River corridor.

3.6.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential wildlife resources impacts have been eliminated from further analysis.

3.6.6.3 Proposed Action (Riverine Habitat Restoration)

The following subsections define potential wildlife resources impacts during the construction and operation phases of the Proposed Action. Construction would be phased, one segment (which could include 1 or more reaches) at a time, beginning upstream at Reach 9 below Jordanelle Reservoir and ending downstream at Reach 2. The phased approach would further limit disturbances of game species to the immediate area of the segment under construction rather than affecting the entire Provo River corridor at the same time. Construction would occur in only one segment at a time, which would allow wildlife to move to undisturbed reaches and avoid the immediate zone of construction activities. This is an important consideration since the Provo River corridor provides the largest area of existing wildlife habitat in the Heber Valley. There is very limited habitat in Heber Valley outside this corridor where wildlife could seek refuge from construction noise and worker activity.

3.6.6.3.1 Impacts During Construction. Construction of the Proposed Action would cause the same types of impacts on wildlife resources described in Section 3.6.6.3.1 of the WCWEP and DRP EIS, except no pipeline or canal would be constructed and riparian woodland and non-riparian wetland habitat would be removed under the Proposed Action instead of upland woodland and sagebrush grassland habitat.

3.6.6.3.1.1 Game Species and Their Habitat. Construction activities would temporarily disturb and displace resident and non-resident mule deer and reduce their use of habitats adjacent to construction areas as a result of increased noise and activity levels. Some mule deer potentially could be killed by construction vehicles, but this would be minimized by strict enforcement of speed limits. Resident mule deer fawn during June and July in riparian woodlands, shrubby areas and mature grasslands at the edge of forested cover. Disturbances during this time may result in lowered fawning success or abandonment of fawning areas. Although some of this habitat type would be removed, SOPs state that these areas would be avoided during fawning season. As a result, there would be no significant impact on important game species habitat such as mule deer fawning areas.

Game species other than deer would likely avoid the immediate areas of construction because of noise and worker activity. No other important habitat for game species occurs in the Provo River corridor except that for mule deer fawning discussed in this section. As a result, no significant impacts would occur to important habitat of other game species.

Certain wildlife habitat types also would be removed during construction of the Proposed Action. Although these areas would be re-vegetated, it would take from two growing seasons to 30 years for habitat to grow to comparable size and height of pre-construction conditions, depending on the habitat type. Table 3-21 summarizes the acres of wildlife habitat that would be disturbed and the number of cottonwood trees that would be removed by construction of the Proposed Action.

Construction of the Proposed Action would remove 9.7 acres of riparian woodlands and 64.5 acres of non-riparian wetlands. Construction would also remove 1,216 cottonwood trees. This would impact mammal and bird game species by eliminating areas of foraging, resting, breeding and cover. Revegetation or development of new habitat as part of the Proposed Action would enhance or create 292.5 total acres of wetland wildlife habitat. Habitat types enhanced or created include 256.5 acres of riverbank and floodplain riparian woodlands and 36.0 acres of non-riparian wetland habitat consisting of shrub wetlands, emergent marsh, open water and side channel wet meadow. This would result in a net increase of 218.3 acres of wetland wildlife habitat.

In addition, approximately 114.7 acres of existing and undeveloped upland and riparian habitats would be permanently protected as wildlife habitat under the Proposed Action. These lands are currently vulnerable to development.

Table 3-21
Acres of Wildlife Habitat and Number of Cottonwood Trees Permanently Removed Under Construction of the Proposed Action

	Habitat Type			
Reach	**Riparian Woodland[1] (acres)**	**Non-Riparian Wetland[2] (acres)**	**Upland (acres)**	**Cottonwood Trees (number of trees)**
1	0.0	0.0	0.0	0.0
2	0.0	3.6	0.0	140
3	3.1	1.7	0.0	79
4	6.0	6.8	4.1	0.0
5	0.4	2.4	5.9	119
6	0.0	3.0	43.1	249
7	0.0	14.4	0.0	74
8	0.2	15.9	0.0	18
9	0.0	16.7	7.5	537
Total	**9.7**	**64.5**	**60.6**	**1,216**

Note:

[1] Riparian woodland includes the riparian wetland vegetation types.

[2] Non-riparian wetland includes the wet meadow, moist meadow, shrub wetland and emergent marsh wetland vegetation types.

The riparian woodland that would develop over the 3- to 30-year time period would be more diverse and provide greater habitat value than the existing riparian woodland. As described in the Wetlands section of this EIS (see Section 3.4) the existing riparian woodland vegetation along the Provo River consists largely of mature cottonwood trees of similar age structure. Very little recruitment has occurred since dike construction. As a result, the existing riparian woodland contains low diversity stands compared to a riparian woodland that is allowed to interact with the floodplain. The interaction (periodic inundation and sediment deposition) allows incremental recruitment of new trees following a flood cycle. The resulting riparian woodland would contain stands of cottonwood trees of mixed age classes with varying heights and stages of development. This creates habitat diversity and allows utilization by increased numbers and types of wildlife compared to a uniform stand of trees of relatively similar age. While it would require 15 to 30 years for the new cottonwood trees to reach a size comparable to the existing trees that would be removed, wildlife use of the new habitat would begin much earlier.

Game species would be adversely impacted during the time it takes for vegetation to be re-established to full habitat value as a result of the lost habitat area, reduced habitat diversity and reduced cover offered by revegetated areas. The time is estimated to be 15 to 30 years for cottonwood trees, 3 to 5 years for the shrub understory that is expected to develop in the riparian woodlands, and two growing seasons for emergent vegetation in non-riparian wetland. As revegetated areas become established, use of the corridor by game species would gradually increase. Since the net change in wetland wildlife habitat acreage would be an increase of 218.3 acres, game species levels would likely increase over baseline conditions. Since construction would be phased under the Proposed Action, habitat would not be removed at the same time, lessening the overall impact of construction. No significant impacts on game species would occur from construction of the Proposed Action because there would be no permanent removal of riparian woodland and non-riparian wetland habitat.

3.6.6.3.1.2 Non-Game Species and Their Habitat.

Noise and activity levels from construction would temporarily disturb and displace resident and seasonal non-game species, resulting in displacement of wildlife from nesting sites, feeding areas and cover. Some of the less mobile wildlife (rodents and amphibians) could be lost by disturbance from construction and heavy equipment. In some cases, small mammals (squirrels, mice and rabbits), which are the primary food source for raptors that frequent the corridor, may be lost. Migratory birds may avoid construction areas, potentially resulting in longer flights to seek undisturbed and less noisy resting and feeding places. Bird losses could occur because there is little alternative suitable habitat for many migratory birds outside the corridor.

Construction activities that remove riparian and non-riparian habitat (see Table 3-20) would cause loss of nesting sites, feeding areas and cover for non-game species. As described under game species and their habitat in Section 3.6.6.3.1.1, more of these habitat types would be developed under the Proposed Action than would be removed during construction. Phased construction would gradually remove this habitat. Revegetation would require 15 to 30 years to reach full habitat value after construction, depending on habitat type. No significant impacts on non-game species are expected to occur from construction of the Proposed Action because there would be no permanent removal of riparian woodland and non-riparian wetland habitat.

The cottonwood trees that provide important nesting and feeding habitat for birds would not mature for 15 to 30 years after revegetation. This could especially impact bird species such as woodpeckers, which are secondary tree dwellers and rely on mature trees with soft wood for constructing nesting cavities and capturing insects. Birds would be impacted during the time it takes for revegetation to re-establish to full wildlife habitat value, which is 15 to 30 years for cottonwoods and 3 to 5 years for the shrub understory. Once re-established, the riparian woodland habitat should provide more habitat value than it does under baseline conditions. Natural recruitment of cottonwood trees would provide mixed stands of several age classes, and the shrub understory is expected have additional species and occupy a wider area under the cottonwood canopy. Thus, there would be a greater diversity of vegetative types in the riparian than under current baseline conditions. The impact of removing cottonwood trees would not be significant for birds and other non-game species since this type of habitat would not be permanently removed and the revegetation following construction is expected to result in a more diverse habitat over a larger area compared to baseline conditions.

Construction would remove 60.6 acres of upland habitat type, primarily in Reach 6 (see Table 3-21 in Section 3.6.6.3.1.1). This would be largely irrigated pasture, not native upland plant species, and no new upland habitat would be developed under the Proposed Action. This habitat type is used by a number of non-game species, but is not as important to non-game species as native upland vegetation or riparian woodland and non-riparian wetland. Irrigated pasture land is also common along the Provo River corridor and Heber Valley. Non-game species are not expected to be significantly impacted because existing native upland habitat along the Provo River corridor would not be permanently removed.

3.6.6.3.2 Impacts After Construction. After construction, the Proposed Action would cause the following types of impacts on wildlife resources:

- Increase in the numbers of game and non-game wildlife and sightings by local landowners as a result of additional area of habitat
- Potential improvement in wildlife habitat along the Provo River corridor by fencing the area to be developed and excluding livestock grazing
- Increased disturbance of game and non-game species as a result of pedestrian access to the Provo River corridor

3.6.6.3.2.1 Game Species and Their Habitats.

Once the revegetated areas are established, distribution of game species would be similar to preconstruction conditions. Additional wildlife habitat only would be developed on land managed by the federal government, not on private property. Adjacent property owners would experience slightly higher levels of game species activity and wildlife sightings because of the increased wildlife habitat. This would probably include increased animal movements across agricultural lands to reach riparian woodland and non-riparian wetland habitats along the Provo River corridor, similar to the situation under baseline conditions.

The access easement area along the Provo River corridor would be fenced to exclude livestock grazing. This would allow riparian and non-riparian vegetation to grow and mature, which would enhance the quality of wildlife habitat used for forage, cover, resting or nesting compared to baseline conditions growth of vegetation for wildlife. This would be a positive impact of the Proposed Action.

Increased pedestrian access would disturb game species, especially during June and July during mule deer fawning. The recreation analysis (see Section 3.16) concluded that angler use of the corridor would increase by 662 percent over baseline. Even though no trails would be developed in the riparian zone, footpaths used by anglers along the river between the access points would become established over time. Other recreationists may use these paths and create additional ones through portions of the riparian zone. The degree of disturbance is not quantifiable, but is expected to be minor since use would be restricted to foot traffic.

3.6.6.3.2.2 Non-Game Species and Their Habitats. Impacts on non-game wildlife and their habitat after construction of the Proposed Action would be generally the same as described for game species in Section 3.6.6.3.2.1.

3.6.6.3.3 Impact Summary. Game species would be temporarily disturbed during construction from noise and human activity, possibly resulting in their displacement from the immediate construction area. Mule deer fawning areas would be avoided. Permanent removal of 9.7 acres of riparian woodland and 64.5 acres of non-riparian wetland habitat types during construction would be offset by enhancement and creation of 292.5 acres of riparian woodland and non-riparian wetland habitat, a net increase of 218.3 acres of wetland wildlife habitat. Approximately 114.7 acres of existing undeveloped upland and riparian habitats would be permanently protected as wildlife habitat under the Proposed Action. Revegetated areas would provide wildlife habitat once they are established, which would take two growing seasons for non-riparian wetland, 3 to 5 years for understory shrub species and 15 to 30 years for overstory cottonwoods in riparian woodlands. Development of additional acreage of riparian woodland and non-riparian wetland habitat and permanent protection of undeveloped upland and riparian habitat would have a positive impact on game species.

Impacts on non-game species and their habitats would be generally the same as described for game species. Development of additional acreage of riparian woodland and non-riparian wetland habitat would have a positive impact on non-game species.

3.6.6.4 Existing Channel Modification Alternative

The following subsections define potential wildlife resources impacts during construction and operation of the Existing Channel Modification Alternative.

3.6.6.4.1 Impacts During Construction. Construction of this alternative would cause the following types of impacts on wildlife resources:

- Disturb and displace resident and non-resident game and non-game species as a result of noise generated by machinery and workers
- Remove riparian woodland and non-riparian wetland habitat used by game and non-game species during the time required for revegetated areas to grow to a size and height that provides wildlife habitat for foraging, cover, resting and breeding

3.6.6.4.1.1 Game Species and Their Habitat. Construction activities would temporarily disturb and displace resident and non-resident mule deer and other game species for the same reasons described for the Proposed Action in Section 3.6.6.3.1.1. SOPs for this alternative require that these mule deer fawning areas be avoided during the fawning period to avoid any impact.

Certain wildlife habitat types also would be removed during construction of this alternative. Although these areas would be revegetated to the extent possible, the time required to grow to comparable size and height of the habitat removed ranges from two growing seasons to 15 to 30 years depending on the habitat type. Table 3-22 summarizes the acres of wildlife habitat and number of cottonwood trees that would be permanently removed by construction of the Existing Channel Modification Alternative.

Table 3-22
Acres of Wildlife Habitat Disturbed and Number of Cottonwood Trees Removed Under the Existing Channel Modification Alternative

Reach	Habitat Type			
	Riparian Woodland[1] (acres)	**Non-Riparian Wetland[2] (acres)**	**Upland (acres)**	**Cottonwood Trees (number of trees)**
1	0.0	0.0	0.0	0
2	8.6	2.3	0.0	140
3	10.1	3.8	0.0	170
4	0.0	2.6	0.0	0
5	0.0	0.0	0.0	0
6	1.3	2.3	0.0	135
7	2.5	0.9	0.0	55
8	8.7	9.1	0.0	230
9	6.4	8.6	0.0	350
Total	**37.6**	**25.5**	**0.0**	**1,080**

Notes:

[1] Riparian woodland includes the riparian wetland and shrub wetland vegetation types.
[2] Non-riparian wetland includes the wet meadow, moist meadow and shrub wetland vegetation types.

A total of 37.6 acres of riparian woodland and 25.5 acres of non-riparian wetland would be removed under this alternative (see Table 3-22). In addition, 1,080 cottonwood trees would be removed. Wildlife habitat removed during construction would be revegetated to the extent possible, and a total of 141.9 acres of riparian woodland habitat would be developed, resulting in a net increase of 78.8 acres of wildlife habitat. Following revegetation, it would take 3 to 5 years for shrubs and 15 to 30 years for cottonwoods to reach a height and size comparable to those removed. This impact would not be significant to game species since there would be no permanent loss of riparian woodland or non-riparian wetland habitat.

3.6.6.4.1.2 Non-game Species and Their Habitats. Construction of the Existing Channel Modification Alternative would result in removal of riparian woodland and non-riparian wetland habitat as described above for game species in Section 3.6.6.4.1.1. This would result in lost nesting, breeding and feeding habitat for many avian species and small mammals during the time described in Section 3.6.6.4.1.1. There would be no significant impacts on non-game wildlife species because riparian woodland or non-riparian wetland habitat would not be permanently removed.

3.6.6.4.2 Impacts After Construction. After construction, this alternative would have the following types of impacts on wildlife resources:

- Resumption of baseline activity levels for game and non-game wildlife as revegetated areas mature
- Potential improvement in wildlife habitat along the Provo River corridor by fencing the area to be developed and excluding livestock grazing
- Minor increased disturbance of game and non-game species as a result of pedestrian access to the Provo River corridor

3.6.6.4.2.1 Game Species and Their Habitat. Potential impacts on game species and their habitat from operation of this alternative would generally be the same as described for the Proposed Action in Section 3.6.6.3.2.1.

Increased pedestrian access could disturb game species, especially during June and July during mule deer fawning. The recreation analysis (Section 3.16) concluded that angler use of the corridor under this alternative would increase by 266 percent over baseline. The impact of footpaths along the riparian zone would be the same as described in Section 3.6.6.3.2.1 above for game species and their habitats.

3.6.6.4.2.2 Non-Game Species and Their Habitats. Impacts on non-game species and their habitats after construction of this alternative would be the same as described in Section 3.6.6.4.1.2 for the Proposed Action.

3.6.6.4.3 Impact Summary. Game species would be temporarily disturbed by noise and human activity during construction, possibly displacing them from the immediate construction area. Mule deer fawning areas would be avoided. The 63.1 acres of riparian woodland and non-riparian wetland habitat types removed during construction would be replaced by revegetation and development of 141.9 acres of riparian woodland and non-riparian wetland habitat. Revegetated areas would provide wildlife habitat once established, which would take two growing seasons to 5 years for non-riparian wetland, 3 to 5 years for understory species in riparian wetlands, and 15-30 years for overstory cottonwoods in the riparian wetlands.

Impacts on non-game species and their habitats are generally the same as described for game species.

3.6.6.5 Instream Structures Alternative

The following subsections define potential wildlife resources impacts during construction and operation of the Instream Structures Alternative.

3.6.6.5.1 Impacts During Construction. Construction of this alternative would cause the following types of impacts on wildlife resources:

- Disturb and displace resident and non-resident game and non-game species from noise generated by construction machinery and workers

3.6.6.5.1.1 Game Species and Their Habitat. Construction activities would disturb and displace resident and non-resident mule deer and other game species for the same reasons described for the Proposed Action in Section 3.6.6.3.1.1. SOPs for the Instream Structures Alternative would prevent disturbance of important game habitat, such as mule deer fawning areas. There would be no significant impacts on important game species habitat since these areas would be avoided during construction.

There would be no significant impacts on wildlife habitat for game species because there would be no permanent removal of riparian woodland or non-riparian wetland habitat.

3.6.6.5.1.2 Non-Game Species and Their Habitats. Construction of this alternative would have the same impacts on non-game species as described in Section 3.6.6.5.1.1 for game species. No non-game wildlife habitat would be permanently removed by construction of this alternative, therefore no significant impacts would occur.

3.6.6.5.2 Impacts After Construction. This alternative would have no impacts on game or non-game species or their habitat after construction. No impacts would occur to adjacent property owners caused by redistribution of wildlife and wildlife habitat because there would be no change from baseline levels of activity.

Increased pedestrian access could disturb some game species, especially during June and July during mule deer fawning. The recreation analysis (Section 3.16) concluded that angler use of the corridor under this alternative would increase by 148 percent over baseline. The impact of footpaths along the riparian zone would be the same as described in Section 3.6.6.3.2.1 above for game species and their habitats.

3.6.6.5.3 Impact Summary. Noise and worker activity during construction of this alternative would temporarily disturb and displace some game and non-game wildlife. No significant impacts are expected because no game or non-game wildlife habitat would be permanently removed. After construction, this alternative would have no significant impact on game or non-game species of wildlife because there would be no changes in wildlife habitat from baseline conditions.

3.6.6.6 No Action Alternative

The No Action Alternative would result in a continuation of the baseline wildlife conditions described in Section 3.6.5. Routine dike maintenance and the associated loss of riparian vegetation along the dikes would continue.

3.7 Threatened, Endangered, and Candidate Species

3.7.1 Introduction

The threatened, endangered and candidate (T&E) species analysis addresses potential impacts on T&E species from the construction and maintenance of the Proposed Action and alternatives. These T&E species designations are defined in the T&E species section of the WCWEP and DRP EIS (Section 3.7.1 of Chapter 3). The information presented in this section was summarized from the Draft Threatened and Endangered Species Technical Report (CUWCD 1996b), which is available upon request. The focus of the analysis is on all T&E species potentially occurring in the impact area of influence. Impacts analyzed include direct, indirect, temporary and long-term effects.

The following species were included in the T&E species analysis: peregrine falcon, bald eagle, Ute ladies'-tresses, spotted frog, whooping crane, June sucker, and Utah valvata snail.

The methods used to assess impacts on T&E species are provided in Appendix B, Section B.3.6. For each species, the following impact topics were analyzed:

- The taking of a species (see Appendix B, Section B.3.6 for a definition of "take")
- Loss or degradation of habitat
- Increased stress, displacement or reduced reproductive success

3.7.2 Issues Eliminated from Further Consideration

Issues that are eliminated from further consideration in the T&E species analysis are the same as described in Section 3.7.2 of the WCWEP and DRP EIS. Species that were eliminated from further consideration because of a low potential for occurrence included whooping crane, June sucker, and Utah valvata snail.

3.7.3 Issues Addressed in the Impact Analysis

The issues that were addressed in the impact analysis are the same as those described in the Section 3.7.3 of the WCWEP and DRP EIS.

3.7.4 Description of the Impact Area of Influence

The impact area of influence is the Provo River corridor between Jordanelle Dam and Deer Creek Reservoir (see Map 3-1 in Section 3.1.1.1). The Provo River consists of the river, floodplain and surrounding riparian and wetland habitats.

3.7.5 Affected Environment (Baseline Conditions)

The affected environment is the same as described in Section 3.7.5 of the WCWEP and DRP EIS, except the PRRP does not include the June sucker among T&E species known to occur in the impact area of influence (see Table 3-23). General life history traits, sighting information and habitat availability also are presented in Section 3.7.5 of the WCWEP and DRP EIS.

3.7.6 Impact Analysis

3.7.6.1 Evaluation Criteria

Evaluation criteria for the T&E species analysis are the same as described in Section 3.7.6.1 of the WCWEP and DRP EIS.

3.7.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential impacts raised during scoping were eliminated from further analysis.

Table 3-23
Summary of T&E Species Known to Occur in the PRRP Impact Area of Influence

Species	Season of Occurrence	Sighting Information	Habitat Type	Habitat Quality
ENDANGERED SPECIES				
Peregrine falcon (*Falco peregrinus*)	Spring and fall migration	No documented occurrences	Emergent marsh, ponds, wet meadow for foraging	Optimal foraging habitat in some areas
THREATENED SPECIES				
Bald eagle (*Haliaeetus leucocephalus*)	Winter	Known to roost and perch near the Provo River	Riparian forest	Optimal roosting habitat along Provo River
Ute ladies'-tresses (*Spiranthes diluvialis*)	Year-round	Two colonies have been identified south of Jordanelle Reservoir near the Provo River	Wetland and riparian habitats	Optimal in habitat along the northern portion of Provo River in Heber Valley and along Snake Creek; marginal to poor elsewhere
C-1 CANDIDATE SPECIES				
Spotted frog (*Rana pretiosa*)	Year-round	Populations near the Provo River between the Jordanelle and Deer Creek reservoirs	Ponds, wet meadow, and emergent marsh	Optimal in areas currently inhabited; marginal to poor elsewhere

3.7.6.3 Proposed Action (Riverine Habitat Restoration)

3.7.6.3.1 Peregrine Falcon. Habitat for peregrine falcons in the impact area of influence consists of areas that attract concentrations of prey, including moist meadow, wet meadow and emergent marsh wetland types. Temporary and long-term direct impacts of habitat loss would occur in all river reaches except Reach 1 (see Map 3-1 in Section 3.1.1.1). Direct, temporary impacts on peregrine falcons would include removal of 22.2 acres of foraging habitat during construction of project features (see Table 3-6 in Section 3.4.6.3.6). These losses would be temporary, lasting two growing seasons until the area is sufficiently revegetated. Construction of the new channel and flood dikes and filling for floodplain development would cause direct, permanent impacts, including the loss of 55.2 acres of foraging habitat (see Table 3-7 in Section 3.4.6.3.6). Some of these long-term habitat losses would be fully replaced under project benefits and wetland restoration.

Beneficial impacts of the Proposed Action would consist of creation, enhancement and protection of 85.3 acres of wet meadow and emergent marsh foraging habitat in all river reaches except Reach 1. These beneficial impacts would result from protection and enhancement of a 64.7-acre parcel of land situated along the Provo River in Reaches 7 and 8, which has been acquired by DOI, plus created habitat shown in Table 3-8 in Section 3.4.6.3.6. The 64.7-acre DOI parcel consists of wet and moist meadow and emergent marsh wetlands that was grazed by livestock under previous ownership. The gain in habitat would offset the direct losses caused by construction, resulting in a net increase of 30.1 acres of habitat. However, impacts would be minimal because of the infrequent and temporary occurrence of peregrine falcons in Heber Valley.

3.7.6.3.2 Bald Eagle. The Proposed Action would result in the direct and permanent removal of 1,216 cottonwood trees and 9.7 acres of riparian woodland that currently provide suitable roosting and perching habitat for bald eagles or would potentially develop into such habitat. The loss of habitat would occur in all stream reaches, except Reach 1, during construction of the new channel and flood dike and filling for floodplain development. Habitat losses would be offset by the restoration of the riparian corridor. Replacement of habitat would take 15 to 30 years for trees to reach a suitable size for roosting. Although a temporary loss of roosting habitat would be detrimental, the impact on bald eagles would be minimal because the Provo River does not support large winter concentrations of bald eagles.

Restoration of a larger and healthier riparian corridor and an increase in fish populations upon completion of the Proposed Action would have long-term benefits for bald eagles. About 256.5 acres of riparian woodland would be developed along the banks of the new channel and in the two-year floodplain in all stream reaches except Reach 1. This would offset the loss of habitat caused by construction, resulting in a net increase in habitat of 246.8 acres.

Construction between November and March would potentially result in temporary and indirect disturbance to roosting individuals. Although it is unlikely that construction would result in a taking of individuals, it could cause temporary relocation of roost sites into adjacent riparian habitat. Bald eagles would likely return to these areas to roost following completion of construction, either in the same season or during the following winter. Disturbance would occur in all stream reaches except Reach 1.

3.7.6.3.3 Ute Ladies'-tresses. The Proposed Action would permanently remove about 74.2 acres of marginal habitat for Ute ladies'-tresses. These losses would occur in all types of wetlands except open water in Reaches 2-9 during construction of the new channel and flood dike and filling for floodplain development (see Table 3-7 in Section 3.4.6.3.6). This habitat is not known to be occupied by Ute ladies'-tresses. The loss of this habitat would be offset by restoration of the riparian corridor. Ute ladies'-tresses also would be affected by the direct but temporary removal of about 24.7 acres of marginal habitat during construction of the project features (see Table 3-6 in Section 3.4.6.3.6). These losses would be temporary, lasting two growing seasons until the area is sufficiently restored. Marginal habitats are not considered important to the continued survival of the species because these areas are common throughout Heber Valley. The temporary loss of habitat would be fully replaced by implementing wetland SOPs. The two known colonies in Heber Valley would not be directly impacted by the Proposed Action.

Over the long-term, the two known colonies of Ute ladies'-tresses in Heber Valley would potentially be indirectly impacted by disruption of the water source, changes in disturbance regime and encroachment of shrubs near the colonies. Impacts would include possible loss of individual plants, reduced reproduction and diminished viability of the population. Known colonies would be protected during construction.

The Proposed Action would have long-term beneficial impacts on Ute ladies'-tresses by improving habitat types throughout the river corridor that the species appears to prefer. This would include development of 286.9 acres of wetland habitat (see Table 3-8 in section 3.4.6.3.6). The gain in habitat would offset the permanent loss of habitat from construction, resulting in a net increase of 212.7 acres of habitat.

3.7.6.3.4 Spotted Frog. The Proposed Action would have adverse impacts on spotted frogs and their habitat, especially in Reaches 7, 8 and 9 (see Map 3-1 in Section 3.1.1.1) where there is known occurrence. Direct, long-term impacts would include the permanent loss of 55.2 acres of emergent marsh and wet/moist meadow habitat from construction of the new channel and flood dikes and the filling of areas for floodplain development. These losses would be offset by restoration of the riparian corridor. During the short-term, 22.2 acres of similar types of habitat would be temporarily removed during construction of project features. These temporary losses would last two years until the vegetation has been restored. Habitats that would be impacted are either known to be occupied by spotted frogs or have a high potential for occupation. Indirect losses of habitat would be fully restored by implementation of wetland SOPs.

Adjustments would be made during the final design to further minimize adverse impacts.

Other direct and indirect impacts would be the same as described in the WCWEP and DRP EIS in Section 3.7.6.4.5. Measures would be necessary to minimize or avoid mortality and reduced reproductive success. The conservation measures described in Section 3.19.5 of the WCWEP and DRP EIS would include measures to avoid mortality or harm reproductive success.

The Proposed Action would have long-term benefits on spotted frogs by creating and enhancing habitat throughout the Provo River corridor. About 90.9 acres of open water, emergent marsh and wet/moist meadow would be created and enhanced by restoring natural functions to the riparian corridor. This gain in habitat would offset direct losses, thereby resulting in a net increase of 35.7 acres of habitat. If the population survives the short-term impacts, the Proposed Action could ultimately contribute to the conservation of the species by increasing its distribution and density.

3.7.6.3.5 Impact Summary. Table 3-24 summarizes potential impacts of the Proposed Action on T&E species.

3.7.6.4 Existing Channel Modification Alternative

3.7.6.4.1 Peregrine Falcon. Habitat for peregrine falcon in the impact area of influence consists of areas that attract concentrations of prey including moist meadow, wet meadow, emergent marsh, and open water wetland types. This alternative would result in direct short-term impacts on peregrine falcons, including the temporary removal of 100.9 acres of foraging habitat during construction of the project features (see Table 3-10 in Section 3.4.6.4.4). These impacts would last two growing seasons until the area is sufficiently revegetated as required by wetland SOPs. Direct and long-term losses include 22.9 acres of habitat in all reaches except Reaches 1 and 4 (see Table 3-11 in Section 3.4.6.4.4). These impacts would result from floodplain grading and placement of fill material in wet/moist meadow areas for construction of new flood dikes. Adverse impacts would be minimal because of the infrequent and temporary occurrence of peregrine falcons in Heber Valley.

3.7.6.4.2 Bald Eagle. Long-term, indirect impacts on bald eagles under the this alternative would include removal of 1,080 cottonwood trees and 37.6 acres of riparian woodland that currently provide suitable roosting and perching habitat or would potentially develop into such habitat. These permanent impacts would be caused by removal of existing dikes in all stream reaches except Reaches 1 and 5. About 141.9 acres of riparian woodland would be developed adjacent to the river channel under this alternative. Development of the riparian woodlands into stands that would provide habitat would take 15 to 30 years. These habitat benefits under the Existing Channel Modification Alternative would offset the adverse impacts from removal of cottonwood trees and riparian woodland, resulting in a net increase of 104.3 acres of habitat.

Temporary and localized disturbance of bald eagles during construction would have minimal impact on bald eagles for reasons described in Section 3.7.6.3.2. The Existing Channel Modification Alternative would have long-term benefits on bald eagles by increasing fish populations upon completion of the PRRP.

3.7.6.4.3 Ute Ladies'-tresses. Ute ladies'-tresses would be impacted by the temporary removal of 116.8 acres of marginal habitat during construction of project features (see Table 3-10 in Section 3.4.6.4.4). This habitat is not known to be occupied by Ute ladies'-tresses. The losses would be temporary, lasting two growing seasons until the areas are restored. There is potential for portions of this area to be developed into riparian woodland overstory, rather than wet/moist meadows used as agricultural land. This alternative would result in permanent removal of 63.1 acres of marginal habitat for Ute ladies'-tresses. In particular, wet/moist meadow and riparian woodland habitats would be directly and permanently impacted in all stream reaches except Reaches 1 and 5 (see Table -11 in Section 3.4.6.4.4). Vegetation would be removed by floodplain grading, placement of fill material and removal of existing dikes. These permanent losses would be offset by the development of additional habitat. Marginal habitats are not considered important to the continued survival of the species because these areas are common throughout Heber Valley. The two known colonies in Heber Valley would not be directly impacted by the Proposed Action.

Table 3-24
Summary of T&E Species Impacts Under the Proposed Action and Alternatives

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Alternative	Type of Potential Impact	Peregrine falcon[1]	Bald eagle[1]	Ute ladies'-tresses	Spotted frog
Proposed Action (Riverine Habitat Restoration)	Taking	No	No	No	Yes
	Temporary increased stress, displacement, or reduced reproductive success	No	Yes	Yes	Yes
	Loss or degradation of habitat *before* conservation[2]	22.2 acres	None	24.7 acres	22.2 acres
	Loss or degradation of habitat *after* conservation[3]	55.2 acres	1,216 mature trees 9.7 acres	74.2 acres	55.2 acres
	Beneficial impacts	85.3 acres	256.5 acres, restoration of Provo River riparian corridor	286.9 acres	90.9 acres
	Net change	Gain of 30.1 acres	Gain of 246.8 acres of habitat, beneficial impacts of river restoration	Gain of 212.7 acres	Gain of 35.7 acres
Existing Channel Modification Alternative	Taking	No	No	No	Yes
	Temporary increased stress, displacement, or reduced reproductive success	No	Yes	Yes	Yes
	Loss or degradation of habitat *before* conservation[2]	100.9 acres	None	116.8 acres	100.9 acres
	Loss or degradation of habitat *after* conservation[3]	22.9 acres	1,080 mature trees 37.6 acres	63.1 acres	22.9 acres
	Beneficial impacts	None	141.9 acres, modification of Provo River	141.9 acres	None
	Net change	Loss of 22.9 acres	Gain of 104.3 acres of habitat, beneficial impacts of river restoration	Gain of 78.8 acres	Loss of 22.9 acres

Table 3-24
Summary of T&E Species Impacts Under the Proposed Action and Alternatives

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Alternative	Type of Potential Impact	Peregrine falcon[1]	Bald eagle[1]	Ute ladies'-tresses[1]	Spotted frog
Instream Structures Alternative	Taking	No	No	No	No
	Temporary increased stress, displacement, or reduced reproductive success	No	No	No	No
	Loss or degradation of habitat *before* conservation[2]	None	None	None	None
	Loss or degradation of habitat *after* conservation[3]	None	None	None	None
	Beneficial impacts	None	Prey habitat improvement in Provo River	None	None
	Net change	None	None	None	None

Notes:

[1] Impacts would be minimal and would not be considered to affect viability of the populations

[2] Impacts on habitat would be direct and temporary until conservation is fully implemented. All habitat loss would be offset by wetland standard operating procedures

[3] Impacts would be indirect and long-term, occurring after the Proposed Action or alternatives are fully implemented

A total of 141.9 acres of riparian woodland habitat would be expected to develop naturally along the bank of the new channel in all reaches except Reaches 1 and 4 (see Table 3-12 in Section 3.4.6.4.4). The riparian woodlands would potentially provide habitat for Ute ladies'-tresses. The gain in habitat would offset the permanent losses from construction, resulting in a net increase of 78.8 acres of Ute ladies'-tresses habitat.

Indirect impacts of the Existing Channel Modification Alternative would be the same as those described for the Proposed Action in Section 3.7.6.3.3. Known colonies would be protected during construction as part of the SOPs.

3.7.6.4.4 Spotted Frog. This alternative would have adverse impacts on spotted frogs and their habitat in Reaches 7, 8 and 9. Direct, long-term impacts would include the permanent loss of 22.9 acres of wet/moist meadow habitat from construction of the new channel and flood dikes and the filling of areas for floodplain development (see Table 3-11 in Section 3.4.6.4.4). This habitat would not be replaced under the Existing Channel Modification Alternative. During the short-term, construction of project features would temporarily disturb 100.9 acres of spotted frog habitat (see Table 3-10 in Section 3.4.6.4.4), which would be restored under the wetland SOPs described in Chapter 1, Section 1.12.9 of the WCWEP and DRP EIS. A portion of this 100.9 acres may be restored as riparian woodland habitat. Habitat that would be impacted is either known to be occupied by spotted frogs or has high potential for occupation.

Other direct and indirect impacts would be the same as described in Section 3.7.6.3.5 of the WCWEP and DRP EIS. The level of impacts would threaten the already questionable viability of the population of spotted frogs in Heber Valley. The conservation measures described in Section 3.19.5 of the WCWEP and DRP EIS include measures to avoid mortality or harm reproductive success.

3.7.6.4.5 Impact Summary. Table 3-24 summarizes potential impacts of the Existing Channel Modification Alternative on T&E species.

3.7.6.5 Instream Structures Alternative

3.7.6.5.1 Peregrine Falcon. Peregrine falcons would not be affected by the Instream Structures Alternative because habitat would not be altered or removed.

3.7.6.5.2 Bald Eagle. This alternative would have beneficial impacts on bald eagles because of increased fish populations in the Provo River. Higher densities of prey would especially benefit bald eagles that winter along the corridor. Construction activities associated with placement of the instream structures would be localized and would not disturb bald eagles.

3.7.6.5.3 Ute Ladies'-tresses. Ute ladies'-tresses would not be affected by this alternative because construction activities would be conducted primarily in the river channel away from areas of known occurrence.

3.7.6.5.4 Spotted Frog. Spotted frogs would not be affected by this alternative because construction would be conducted primarily in the river channel. Required areas of disturbance for material stockpiles would be carefully selected to avoid impacts on existing habitat.

3.7.6.5.5 Impact Summary. Table 3-24 summarizes potential impacts of the Instream Structures Alternative on T&E species.

3.7.6.6 No Action Alternative

The No Action Alternative would have no impacts on peregrine falcons, bald eagles, Ute ladies'-tresses, spotted frogs or their habitat. Baseline conditions would continue as described in Section 3.7.5.

3.8 Soil Resources

3.8.1 Introduction

The soil resources analysis addresses potential impacts on soil resources from the construction and maintenance of the PRRP Proposed Action and alternatives. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.7. The following soil resources impact topics are addressed in the impact analysis:

- Soil erosion and stability
- Soil quality

3.8.2 Issues Eliminated From Further Analysis

None of the soil-related issues raised during scoping and defined in Section 3.8.3 have been eliminated from further analysis.

3.8.3 Issues Addressed in the Impact Analysis

The following issues were raised in scoping and are addressed in the soil impact analysis:

- What impacts would stabilization or realignment of the Provo River have on soils?
- How would soil quality and productivity change in areas affected by the PRRP?
- Would land reclaimed by filling the old river channel under the Proposed Action be covered with enough topsoil and be of sufficient quality to conduct farming activities?

3.8.4 Description of Impact Area of Influence

The impact area of influence consists of lands in, and immediately adjacent to, the Provo River corridor that would be impacted by the PRRP. The corridor extends 1,500 feet east and west from me centerline of the river. Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence.

3.8.5 Affected Environment (Baseline Conditions)

Soils in the vicinity of the Provo River are those of the Kovich, Fluventic Haploborolls, and Crooked Creek association, which consist of moderately well-drained to poorly drained, deep soils formed in mixed alluvium on floodplains, low stream terraces and valley bottoms. These soils occur primarily on Heber Valley bottom lands associated with Snake Creek and the Provo River.

3.8.6 Impact Analysis

3.8.6.1 Significance Criteria

The significance criteria used in the PRRP soils analysis are the same as those defined in Section 3.8.6.1 of the WCWEP and DRP EIS.

3.8.6.2 Potential Impacts Eliminated From Further Analysis

The following potential impact was eliminated from further consideration:

- Would land reclaimed by filling the old river channel under the Proposed Action be covered with enough topsoil and be of sufficient quality to conduct farming activities?

The former river channel would be used for wetland and other riparian habitat purposes. Therefore, reclamation of soil resources for agriculture would not occur in the old river channel.

3.8.6.3 Proposed Action (Riverine Habitat Restoration)

3.8.6.3.1 Soil Erosion and Stability During Construction. Project construction activities would likely lead to a small increase in erosion of the Provo River stream bottom and bank during and immediately after construction. This impact is expected to be minor since the terrain is nearly level and the Proposed Action construction procedures would prevent significant levels of erosion. Construction procedures would include installation of temporary diversion dikes, interceptor ditches, sediment traps and detention basins as described in Section 1.7.3.3 of PRRP EIS Chapter 1.

3.8.6.3.2 Soil Erosion and Stability After Construction. After construction, streambank erosion levels would be reduced by lower flow velocities and project improvements such as streambank stabilization and increased riparian vegetation.

3.8.6.3.3 Soil Quality. The Proposed Action is not expected to change baseline soil quality in the impact area of influence. Since construction activities would largely be confined to the existing river channel and adjacent areas in the construction easement, there would be little potential for impacts on soil quality of adjacent lands outside the river corridor. The setback dikes along the edge of the 100-year floodplain would be graded to blend with the existing fields and would be constructed and revegetated to near pre-construction conditions. The use of the erosion control SOPs (as defined in Section 1.12.9 of the WCWEP and DRP EIS) also would help restore soils to pre-construction conditions.

Results of the groundwater analysis (see PRRP EIS Section 3.2) indicate the Proposed Action would have only a minor effect on groundwater elevations under adjacent agricultural lands. This change would not cause significant impacts on physical and chemical conditions of the soil because the groundwater table elevation would be essentially the same as baseline conditions.

3.8.6.3.4 Impact Summary. Construction activities would cause a minor and gradual increase in streambank and streambed erosion during and immediately after construction. The Proposed Action would result in a long-term reduction in erosion. Minor changes in groundwater elevations under adjacent lands are not expected to affect soil quality. None of these impacts are expected to be significant.

3.8.6.4 Existing Channel Modification Alternative

3.8.6.4.1 Soil Erosion and Stability During Construction. Adverse soil erosion and stability impacts during and immediately after construction would be avoided and minimized by using appropriate construction procedures and SOPs described in Section 1.12.9 of the WCWEP and DRP EIS. Coffer dams would be constructed in the middle of the river parallel to the direction of stream flow. Streamflows then would be gradually introduced into each section after construction is completed. The stream bottom and banks would be stabilized and sediment removed before breaching the coffer dams to minimize increases in erosion. No significant soil erosion or stability impacts would occur.

3.8.6.4.2 Soil Erosion and Stability After Construction. This alternative would result in a short-term reduction in riparian vegetation. However, improvements associated with this alternative would result in a long-term increase in riparian vegetation and a reduction in streambed erosion. Releases from Jordanelle Reservoir and Provo River streamflows would be managed during the first 5 years after construction is completed to facilitate the re-establishment of riparian vegetation.

3.8.6.4.3 Soil Quality. Adverse impacts on soil quality are not expected for the same reasons defined in Section 3.8.6.3.3.

3.8.6.4.4 Impact Summary. The potential impacts of this alternative on soil resources would essentially be the same as those described for the Proposed Action in Section 3.8.6.3.4. The potential streambank and streambed erosion impacts of this alternative would be about the same as the Proposed Action during and immediately after construction. There also would be a reduction in long-term streambed erosion. None of the adverse impacts would be significant.

3.8.6.5 Instream Structures Alternative

3.8.6.5.1 Soil Erosion and Stability During Construction. Adverse soil erosion and stability impacts during and immediately after construction would be minor, minimized and avoided when possible using appropriate construction procedures and SOPs. Since this alternative would not include modifications to the Provo River channel, potential impacts would be less than those from the Proposed Action or Existing Channel Modification Alternative. No significant soil erosion or stability impacts would occur.

3.8.6.5.2 Soil Erosion and Stability After Construction. Habitat improvements included in this alternative would slightly reduce streambank and streambed erosion. However, these reductions are expected to be very minor because riparian vegetation along the Provo River would be about the same as baseline conditions. It would not include many flow-reducing improvements in the channel and existing erosion levels would continue.

3.8.6.5.3 Soil Quality. Adverse impacts on soil quality are not expected for the same reasons defined in Section 3.8.6.3.3.

3.8.6.5.4 Impact Summary. The potential streambank and streambed erosion impacts of this alternative would be minor during and immediately after construction and less than the other PRRP action alternatives since modification to the Provo River channel is not included in this alternative.

3.8.6.6 No Action Alternative

The No Action Alternative would have no impacts on soil resources. Baseline conditions would continue as described in Section 3.8.5 under the No Action Alternative.

3.9 Mineral and Energy Resources

3.9.1 Introduction

This analysis addresses potential impacts on mineral and energy resources from the construction and maintenance of the Proposed Action and alternatives. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.8. The following mineral and energy resources impact topics are addressed in the impact analysis:

- Existing and planned mineral resource sites in Heber Valley
- Energy used during and after construction

3.9.2 Issues Eliminated From Further Analysis

None of the mineral and energy resource issues raised during scoping and defined in Section 3.9.3 have been eliminated from further analysis.

3.9.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- Would Heber Valley mineral resources be affected by the Proposed Action and alternatives?

- What changes in energy consumption would occur during construction, operation and maintenance of the Proposed Action and alternatives?

3.9.4 Description of Impact Area of Influence

The impact area of influence for the mineral and energy resources analysis consists of existing and planned mineral resource sites in Heber Valley, construction sites along the Provo River, and roads that would be used by construction workers and recreationists attracted to the new Provo River recreation opportunities.

3.9.5 Affected Environment (Baseline Conditions)

The following mineral resource sites are situated in Heber Valley: two existing gravel mining operations in the Daniel Creek vicinity, an existing sandstone quarry in the Lake Creek vicinity, an existing private quarry near Jordanelle Dam and a potential gravel mining operation in the Lake Creek vicinity. Rock needed for borrow material during construction of the Instream Structures Alternative would come from one of these areas. Waste material created by the Proposed Action and the Existing Channel Modification Alternative would be deposited in one of these areas.

Roads where energy would be used for construction activities and that workers would use to commute to and from construction sites are identified in Section 3.18 (Transportation). Roads where additional energy would be used for angler and other recreation access to the enhanced Provo River are also identified in Section 3.18.

3.9.6 Impact Analysis

3.9.6.1 Significance Criteria

Impacts on mineral resources in Heber Valley are considered significant if 1) extraction of mineral resources would be precluded or obstructed, 2) if existing borrow supplies at mineral resource sites would not be sufficient to supply the project and new sites would have to be developed, or 3) if existing sites do not have the capacity to accept all of the spoil material and new sites have to be developed.

Energy resource impacts are considered significant if the use of energy associated with the Proposed Action and alternatives would be wasteful, i.e., if it exceeds the amount of energy typically used by projects of this type or feasible energy conservation measures are not successfully implemented.

3.9.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential mineral and energy resource impacts have been eliminated from further analysis.

3.9.6.3 Proposed Action (Riverine Habitat Restoration)

3.9.6.3.1 Mineral Resources in Heber Valley. Off-site rock material would not be needed for the Proposed Action. However, large quantities of waste material would be generated by channel excavation. As described in Chapter 1, Section 1.11.5, some of this material would be used on-site. It is expected that the remainder would be hauled to an existing large-material extraction site for later sorting and processing and use as construction material. Extraction of mineral resources would not be precluded by this waste material. The impacts of this alternative on mineral resources would not be significant based the significance criteria in Section 3.9.6.1.

3.9.6.3.2 Energy Used During and After Construction. A total of 142,600 gallons of gasoline would be used during construction the Proposed Action. Of this total, 85,600 gallons would be used by construction vehicles and 57,000 gallons would be used by workers as they commute to construction sites. After construction is completed, recreationists would use energy as they drive to the Provo River from Salt Lake City, Provo, Orem, Heber Valley and other areas.

The energy use described above is typical of these types of projects. These impacts would not be significant based on the energy significance criteria.

3.9.6.3.3 Impact Summary. Spoil material created by this alternative would be deposited at an existing excavation site. Approximately 142,600 gallons of fuel would be used during construction and some energy would be used by recreationists.

3.9.6.4 Existing Channel Modification Alternative

3.9.6.4.1 Mineral Resources in Heber Valley. No off-site rock material would be needed for this alternative. However, large quantities of waste material would be generated by channel excavation, as described in Section 1.11.5, while some would be used on-site. It is expected that the remainder would be hauled to the gravel extraction site in the Daniel Creek vicinity, for later sorting and processing and use as construction material. Extraction of mineral resources would not be precluded by this waste material. The impacts of this alternative on mineral resources would not be significant based the significance criteria in Section 3.9.6.1.

3.9.6.4.2 Energy Used During and After Construction. A total of 106,300 gallons of gasoline would be used during construction of this alternative. Of this total, 58,300 gallons of gasoline would be used by construction vehicles and 48,000 gallons would be used by workers commuting to construction sites. After construction is completed, recreationists would use energy as they drive to the Provo River from Salt Lake City, Provo, Orem, Heber Valley and other areas.

The energy use described above is typical of these types of projects. These impacts would not be significant based on the energy significance criteria in Section 3.9.6.1.

3.9.6.4.3 Impact Summary. Spoil material created by this alternative would be deposited at an existing excavation site. Approximately 106,300 gallons of fuel would be used during construction, and some energy would be used by recreationists.

3.9.6.5 Instream Structures Alternative

3.9.6.5.1 Mineral Resources in Heber Valley. This alternative would require 13,106 cubic yards of off-site rock borrow material (see Table 1-14 in Section 1.11.5 of Chapter 1), which would be extracted from an existing site. No spoil material would be created by this alternative. Construction and recreation traffic generated by this alternative would not preclude the extraction of minerals from any existing or planned mineral resource sites in Heber Valley. These impacts would not be significant based on the mineral resource significance criteria in Section 3.9.6.1.

3.9.6.5.2 Energy Used During and After Construction. A total of 4,000 gallons of gasoline would be used during construction of this alternative. Of that total, 1,300 gallons would be used by construction vehicles and 2,700 gallons would be used by workers commuting to construction sites. After construction is completed, recreationists would use energy as they drive to the Provo River from Salt Lake City, Provo, Orem, Heber Valley and other areas.

The energy use described above is typical of these types of projects. These impacts would not be significant based on the mineral resource significance criteria in Section 3.9.6.1.

3.9.6.5.3 Impact Summary. Spoil material created by this alternative would be deposited at an existing excavation site. Approximately 4,000 gallons of fuel would be used during construction, and some energy would be used by recreationists

3.9.6.6 No Action Alternative

The No Action Alternative would have no impacts on mineral and energy resources. Baseline conditions would continue as described in Section 3.9.5 under the No Action Alternative.

3.10 Air Quality

3.10.1 Introduction

The air quality analysis addresses potential impacts on air quality from the construction and maintenance of the Proposed Action and alternatives. The methodology used to conduct the air quality analysis is described in Appendix B, Section B.3.9. The following topics are included in the impact analysis:

- Vehicles emissions during construction
- Emissions from recreation traffic
- Dust emitted from construction procedures and agricultural practices

3.10.2 Issues Eliminated From Further Analysis

None of the air quality issues raised during scoping were eliminated from further analysis.

3.10.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the air quality impact analysis:

- What effects would the Proposed Action and alternatives have on air quality during construction?
- What effects would increased recreational use of the Provo River have on air quality?
- Would the agricultural impacts of the PRRP affect air quality?

3.10.4 Description of Impact Area of Influence

The air quality impact area of influence includes areas along the Provo River between Jordanelle and Deer Creek reservoirs where the Proposed Action and alternatives would be constructed and roads that would be used by construction or recreation traffic (primarily Highways 40, 113 and 189 and River Road). Map 3-1 in Section 3.1.1.1 shows the direct impact of influence.

3.10.5 Affected Environment (Baseline Conditions)

The affected air quality environment is the same as described for the Heber Valley in Section 3.10.3.5 of the WCWEP and DRP EIS.

3.10.6 Impact Analysis

3.10.6.1 Significance Criteria

The significance criteria are the same as described in Section 3.10.6.1 of the WCWEP and DRP EIS.

3.10.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential air quality impacts of the PRRP have been eliminated from further analysis.

3.10.6.3 Proposed Action (Riverine Habitat Restoration)

3.10.6.3.1 Vehicle Emissions During Construction. The Proposed Action would increase vehicle emissions in Heber Valley during construction. Table 3-25 shows the maximum vehicle emissions during any 12-month period of construction, including worst-case estimates that assume equipment would operate through all normal working hours during construction. None of these air quality impacts would be significant because they are well below the 250-ton threshold included in the significance criteria.

3.10.6.3.2 Emissions From Recreation Traffic. The Proposed Action would increase recreation opportunities along the Provo River between Jordanelle and Deer Creek reservoirs. This would indirectly increase recreation traffic and vehicle emissions on roads used by recreationists (primarily Highways 40, 189, 113 and River Road). The air quality standards defined in Section 3.10.6.1 of the WCWEP and DRP EIS would not be violated because they only apply to direct air quality impacts of a project, such as those caused by emissions from construction vehicles.

3.10.6.3.3 Dust Emissions. Dust would become airborne during construction of the Proposed Action. However, the SOPs defined in Section 1.12.9 of the WCWEP and DRP EIS include periodic watering of equipment, spoil piles and dirt roads, which would prevent large amounts of dust from being emitted.

The Proposed Action also would remove agricultural land from production during construction (see

Table 3-25
Maximum Vehicle Emissions During Any 12-Month Period of Construction
(tons)

	Nitrogen Oxides (NO_x)[a]	Sulfur Oxides (SO_x)[b]	Particulates (PM_{10})[c]
Proposed Action (Riverine Habitat Restoration)	80	17	5
Existing Channel Modification Alternative	78	7	6
Instream Structures Alternative	23	2	2

Notes:

[a] NOx is nitrogen oxides, which are pollutants from combustion

[b] SOx is sulfur oxides, which are pollutants from combustion

[c] PM_{10} or particulate matter less than 10 microns in diameter

Section 3.11, Agriculture), which also would reduce related dust emissions along the Provo River.

3.10.6.3.4 Impact Summary. The Proposed Action would increase NOx, SOx and PM_{10} vehicle emissions during construction and after construction as recreationists drive to the Provo River. Dust emissions would increase during construction and decrease after construction in areas where agricultural land would be removed from production.

3.10.6.4 Existing Channel Modification Alternative

3.10.6.4.1 Vehicle Emissions During Construction. Table 3-25 defines the maximum vehicle emissions during any 12-month period of constructing this alternative. None of these air quality impacts would be significant because they are well below the 250-ton threshold included in the significance criteria.

3.10.6.4.2 Emissions From Recreation Traffic. Recreation-related emissions would be the same as described for the Proposed Action in Section 3.10.6.3.2, except fewer recreationists would be attracted to the Provo River under this alternative.

3.10.6.4.3 Dust Emissions. Dust emissions would be the same as described for the Proposed Action in Section 3.10.6.3.3, except reductions in emissions after construction would be less under this alternative because it would remove much less agricultural land from production.

3.10.6.4.4 Impact Summary. The Existing Channel Modification Alternative would cause an increase in NOx, SOx and PM_{10} vehicle emissions during construction and after construction as recreationists drive to the Provo River. Dust emissions would increase during construction and decrease after construction in areas where agricultural land would be removed from production.

3.10.6.5 Instream Structures Alternative

3.10.6.5.1 Vehicle Emissions During Construction. Table 3-25 defines the maximum vehicle emissions during any 12-month period of constructing this alternative. None of these air quality impacts would be significant because they are well below the 250-ton threshold included in the significance criteria.

3.10.6.5.2 Emissions From Recreation Traffic. Recreation-related emissions are the same as described for the Proposed Action in Section 3.10.7.3.2, except fewer recreationists would be attracted to the Provo River under this alternative.

3.10.6.5.3 Dust Emissions. Construction of this alternative would cause a minor increase in dust emissions during construction, but SOPs would minimize the amount.

3.10.6.5.4 Impact Summary. This alternative would cause an increase in vehicle emissions during construction and after construction as recreationists drive to the Provo River. There also would be a minor increase in dust emissions during construction.

3.10.6.6 No Action Alternative

The No Action Alternative would have no impacts on air quality. Baseline conditions would continue as described in Section 3.10.5 of the WCWEP and DRP EIS.

3.11 Agricultural Resources

3.11.1 Introduction

This analysis addresses potential impacts on agricultural resources from the construction and maintenance of the Proposed Action and alternatives. Assumptions and impact topic analysis methods used in the analysis are included in Appendix B, Section B.3.10. The following impact topics are addressed in the agricultural resources impact analysis:

- Livestock grazing and production
- Cropland and crop production
- Agricultural practices and operations

3.11.2 Issues Eliminated From Further Analysis

None of the agricultural resource related issues identified during scoping have been eliminated from further analysis.

3.11.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What impacts would potential increases in water table elevations have on existing farming operations adjacent to the river?
- Would land reclaimed by filling the old river channel under the Proposed Action (Riverine Habitat Restoration) be covered with sufficient topsoil to conduct farming activities? Could this reclaimed land be used by farmers and ranchers with adjacent property?
- What impacts would the PRRP have on farming operations that would be divided by the Proposed Action? How would irrigation water be provided to both sides of the river where a farm is presently on one side of the river?
- What impacts would occur to livestock crossing and watering on private land under the PRRP?
- What impacts would the PRRP have on landowner access to farms divided by the Proposed Action? Would river crossings be provided to access divided farmlands?
- What would be the construction effects, including access for construction, on farms and ranches and how would they be minimized?
- What opportunities would there be for ranchers and farmers along the river to maintain control of their private land and provide easements for fisherman access?
- What would be the impacts of restrictions on motorized equipment crossing the river, and how would these impacts be mitigated to accommodate existing access by farmers and ranchers?
- How would increased public access along the river affect farming activities?
- What impacts would improvement of threatened and endangered species habitats along the river have on future agricultural uses?
- How would existing agricultural access along the river be impacted by breaching of the dikes under the Proposed Action?

3.11.4 Description of Impact Area of Influence

The impact area of influence consists of agricultural lands along the Provo River corridor that would be potentially affected as a result of the Proposed Action and alternatives. It extends about 200 to 2,200 feet wide along the centerline of the Provo River between Jordanelle Dam and Deer Creek Reservoir. Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence.

3.11.5 Affected Environment (Baseline Conditions)

This section defines the agricultural resources that would be affected by the Proposed Action and alternatives. These resources include irrigated pasture and grazing land that is not irrigated.

Table 3-26 summarizes acreage, average yield and productivity under baseline conditions. The cropping pattern under baseline conditions would be about 92 percent flood-irrigated pasture (361.4 acres) and 8 percent non-irrigated grazing land (33.5 acres). Under baseline conditions, total annual production would be 2,406 animal unit months (AUMs).

Farmers along the Provo River corridor have identified the following items as important to their operations: the maintenance of river crossings; river access for livestock watering; fencing to separate agriculture and livestock operations from other incompatible land uses; and the control of public access to avoid conflicts with farming and ranching (Bear West 1993). They also stated existing levees are a functional part of many agricultural and livestock operations.

3.11.6 Impact Analysis

3.11.6.1 Significance Criteria

The significance criteria used in the PRRP agricultural analysis are the same as those described in Section 3.11.6.1 of the WCWEP and DRP EIS.

Table 3-26
Summary of Acreage, Average Yield and Productivity
Under PRRP Baseline Conditions

Crop[1]	Units/Acre	Total Acreage	Average Yield/Acre	Total Production
Pasture	AUMs[2]	361.4	6.5	2,349
Grazing Land	AUMs	33.5	1.7	57

Notes:

[1] Cropland used for pasture is flood irrigated and grazing land is not irrigated.

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

3.11.6.2 Potential Impacts Eliminated From Further Analysis

The following potential impacts on agricultural resources were eliminated from further analysis because they are not expected to occur under the Proposed Action and alternatives:

- What impacts would potential increases in water table elevations have on existing farming operations adjacent to the river?

  Impacts on baseline water table elevations from the Proposed Action were found to be minor (see Section 3.2, Water Resources). The water resources analysis concluded that the Existing Channel Modification and Instream Structures alternatives would not cause any impacts on groundwater levels along the Provo River. Since impacts of the Proposed Action on baseline water table elevations do not have the potential to affect soil or agricultural resources, there would be no impacts on farming operations.

- Would land reclaimed by filling the old river channel under the Proposed Action be covered with sufficient topsoil to conduct farming activities? Could this reclaimed land be used by farmers and ranchers with adjacent property?

  Old river channel areas would be reclaimed for uses other than farming, such as riparian vegetation and wetlands.

- What opportunities would there be for ranchers and farmers along the river to maintain control of their private land and provide easements for fisherman access?

  Some agricultural land would be acquired under baseline conditions to establish a public access corridor along the Provo River. These lands would be fenced, and access would be provided for anglers. Additional land would be acquired and fenced to provide public access and protect sensitive resources. Agricultural land uses would not be allowed on fenced lands, but would be allowed on additional lands acquired for flood easements under the Proposed Action and Existing Channel Modification Alternative.

3.11.6.3 Proposed Action (Riverine Habitat Restoration)

This section describes the impacts of the Proposed Action on agricultural production, practices and operations.

3.11.6.3.1 Livestock Grazing and Production. Impacts on livestock grazing and production during construction of the Proposed Action would include lands permanently removed and lands temporarily removed for access only during construction. Table 3-27 summarizes the impacted acreage and related loss of production from pasture and grazing land due to temporary disturbances during construction. These lands would be restored to their original use after completion of construction.

Table 3-27
Summary of Impacts on Pasture and Grazing Land From Temporary Disturbances During Construction of Proposed Action and Alternatives[1]

Alternatives	Irrigation Method	Grazing Land		Pasture	
		Acreage	Total AUMs[2]	Acreage	Total AUMs
Proposed Action	None	1.2	2	NA	NA
(Riverine Habitat Restoration)	Flood	NA	NA	9.4	61
Existing Channel Modification	None	NA	NA	NA	NA
Alternative	Flood	NA	NA	0.7	5
Instream Structures Alternative	None	NA	NA	NA	NA
	Flood	NA	NA	0.7	5

Notes:

[1] Acreage and production on lands temporarily disturbed during construction and then returned to agricultural use.

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-28 shows the impacts on pasture and grazing land permanently removed under the Proposed Action and alternatives. These impacts would be caused by agricultural land permanently removed by land acquisition and other construction procedures. These lands would not be restored to their original use after construction.

Table 3-29 is a summary of AUM production losses during construction of the Proposed Action and alternatives.

The temporary disturbance and permanent removal of grazing lands caused by the Proposed Action would reduce productivity by a total of about 44 AUMs. Temporary disturbances would occur on approximately 1.2 acres of grazing lands and approximately 24.5 acres of grazing land would be permanently removed from production. Impacts on irrigated pasture are described in Section 3.11.6.3.2.

Table 3-30 shows the annual loss of production after construction of the Proposed Action and alternatives. This loss, which would be caused by the permanent removal of agricultural land, is important because it would cause related socioeconomic impacts on farming enterprises and other elements of Wasatch County's economy (see Section 3.12). The Proposed Action would cause an annual loss of 42 AUMs per year from grazing land permanently removed.

Table 3-31 shows the impacts from periodic flood inundation under the Proposed Action and alternatives. Expansion of the floodplain under the Proposed Action would cause temporary and minor production impacts on inundated lands. The magnitude of the impacts would vary based on the magnitude of the flood event. A 2-year flood event would be expected to occur every 2 years based on historic hydrology data, a 10-year flood event would be expected to occur every 10 years, etc. Land would be flooded for 2 weeks or less during any flood event, but it is estimated that flooded lands would be lost from production for half the growing season to allow for adequate drying before they are returned to use.

Table 3-28
Summary of Impacts on Pasture and Grazing Land From Permanent Removal Under the Proposed Action and Alternatives[1]

Alternatives	Irrigation Method	Grazing Land		Pasture	
		Acreage	Total AUMs[2]	Acreage	Total AUMs
Proposed Action	None	24.5	42	NA	NA
(Riverine Habitat Restoration)	Flood	NA	NA	178.6	1161
Existing Channel Modification	None	NA	NA	NA	NA
Alternative	Flood	NA	NA	7.6	49
Instream Structures	None	NA	NA	NA	NA
Alternative	Flood	NA	NA	NA	NA

Notes:

[1] Crop acreage and production permanently removed during land acquisition and other construction procedures.

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-29
Summary of Production Impacts During Construction of Proposed Action and Alternatives[1]

Alternative	Grazing Land AUMs[2]	Pasture AUMs	Total AUMs
PROPOSED ACTION (RIVERINE HABITAT RESTORATION)			
Baseline	57	2,349	2,406
Temporary Disturbance	2	61	63
Permanent Removal	42	1,161	1,203
Total Decrease	-44	-1,222	-1,266
Percent Change	-76.7	-52.0	-52.6
EXISTING CHANNEL MODIFICATION ALTERNATIVE			
Baseline	57	2,349	2,406
Temporary Disturbance	0	5	5
Permanent Removal	0	49	49
Total Decrease	0	-54	-54
Percent Change	0	-2.3	-2.2
INSTREAM STRUCTURES ALTERNATIVE			
Baseline	57	2,349	2,406
Temporary Disturbance	0	5	5
Permanent Removal	0	0	0
Total Decrease	0	-5	-5
Percent Change	0	-0.2	-0.2

Notes:

[1] Change in crop production during construction from temporary disturbance and permanent removal of agricultural lands.

[2] AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-30
Summary of Annual Loss of Production After Construction of Proposed Action and Alternatives

Alternative	Grazing Land AUMs*	Pasture AUMs	Total AUMs
PROPOSED ACTION (RIVERINE HABITAT RESTORATION)			
Baseline	57	2,349	2,406
Total Decrease	-42	-1,161	-1,203
Percent Change	-73.1	-49.4	-50.0
EXISTING CHANNEL MODIFICATION ALTERNATIVE			
Baseline	57	2,349	2,406
Total Decrease	NA	-49	-49
Percent Change	NA	-2.1	-2.1
INSTREAM STRUCTURES ALTERNATIVE			
Baseline	57	2,349	2,406
Total Decrease	NA	NA	NA
Percent Change	NA	NA	NA

Notes:

*AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

Table 3-31
Summary of Impacts from Flood Inundation Under Proposed Action and Alternatives

Land Type	Flood Frequency	Inundated Acres (and Related Lost Production in AUMs)		
		Proposed Action (Riverine Habitat Restoration)	Existing Channel Modification Alternative	Instream Structures Alternative
Grazing Land	2-Year	3 (3)	NA	NA
	10-Year	9.4 (8)	NA	NA
	100-Year	12.9 (11)	NA	NA
Pasture	2-Year	20.9 (68)	NA	NA
	10-Year	40.5 (132)	NA	NA
	100-Year	212.5 (691)	4.0 (13)	NA
Total	2-Year	23.9 (70)	NA	NA
	10-Year	49.9 (140)	NA	NA
	100-Year	225.4 (702)	4.0 (13)	NA

Notes:

*AUMs are animal unit months, the amount of forage (800 pounds dry matter) required to feed one cow and calf for one month.

3.11.6.3.2 Cropland and Crop Production. The Proposed Action would cause temporary disturbances to and permanent removal of pasture during construction. A total of approximately 1,222 AUMs would be lost from pasture lands during construction of the Proposed Action (see Table 3-29). The annual loss of production from pasture after construction would be about 1,161 AUMs (see Table 3-30).

Periodic flood inundation under the Proposed Action would result in temporary impacts on pasture production, as defined in Table 3-31. The amount of production lost would vary depending on the magnitude of the flood event. A 100-year flood event would cause a production loss of about 691 AUMs on pasture lands.

3.11.6.3.3 Agricultural Practices and Operations. The following items could impact agricultural practices and operations: land acquisition and other construction procedures; the agricultural production impacts described in Section 3.11.6.3.2; the location of the new Provo River channel, side channels and ponds in relation to agricultural facilities and practices; and access restrictions, including restrictions on crossing the river with vehicles and equipment. Related impacts on practices and operations could include modifications to irrigation systems, disruption of grazing management practices, changes in cultivation practices and changes to transportation routes. Some of these impacts may be avoided by final placement of side channels and other project features during the final design phase of the Proposed Action (which occurs after the EIS process). The SOPs described in Section 1.11.9.1 of the WCWEP and DRP EIS would help minimize and avoid adverse impacts by compensating farmers and landowners for lost production in the land value assessment process and the direct costs needed to modify agricultural facilities and operations. Significant impacts on individual farming enterprises would not occur because the SOPs and the permanent loss of land generally would be spread along the length of the river. Thus, the loss of land and production would be spread among multiple land owners.

Increased recreational use along the Provo River could lead to additional trespassing on adjacent farms and interfere with agricultural practices and operations. It is likely that trespassing would be limited since public access would be restricted to the Provo River corridor through specific access points acquired for entry and adjacent farmlands would be fenced.

3.11.6.3.4 Impact Summary. The Proposed Action would cause a total loss of 1,266 AUMs during construction and 1,203 AUMs annually after construction. Impacts on agricultural practices would include modifications to irrigation systems, disruptions in grazing patterns, and changes in cultivation and local access. Periodic flood events also would cause a minor and temporary loss of production on inundated lands.

3.11.6.4 Existing Channel Modification Alternative

3.11.6.4.1 Livestock Grazing and Production. This alternative would not disturb or remove grazing lands during construction, and grazing land would not be subject to potential impacts from periodic flood inundation. Changes in livestock grazing and production would therefore not occur under this alternative.

3.11.6.4.2 Cropland and Crop Production. This alternative would cause temporary disturbances to and permanent removal of pasture during construction. The temporary disturbance would cause a loss of production on 0.7 acres of pasture (see Table 3-27). The Existing Channel Modification Alternative also would permanently remove 7.6 acres of pasture (see Table 3-28). The total loss of production during construction would be minor (about 54 AUMs).

Expansion of the 100-year floodplain and periodic inundation would result in temporary and minor impacts on 4.0 acres of pasture (see Table 3-31). These lands would not be subject to more frequent (2- and 10-year) flood events.

3.11.6.4.3 Agricultural Practices and Operations. Impacts on agricultural practices and operations could occur during and after construction. Significant impacts on agricultural practices and operations would not be expected with such a minor loss of acreage and because of the SOPs.

3.11.6.4.4 Impact Summary. This alternative would cause a loss in production of 54 AUMs during construction and an annual loss of 49 AUMs after construction. Periodic and limited-duration flood inundation also would cause a minor loss of production on affected lands.

3.11.6.5 Instream Structures Alternative

3.11.6.5.1 Livestock Grazing and Production. This alternative would not disturb or remove grazing lands during or after construction. Grazing land would not be subject to periodic flood inundation under this alternative.

3.11.6.5.2 Cropland and Crop Production. This alternative would cause a minor and temporary disturbance of pasture during construction. This would cause a minor and temporary loss of production of 5 AUMs on 0.7 acres of pasture (refer to Table 3-27). Pasture would not be subject to periodic flood inundation under this alternative.

3.11.6.5.3 Agricultural Practices and Operations. This alternative would not likely cause impacts on agricultural practices and operations.

3.11.6.5.4 Impact Summary. This alternative would cause a loss of production of 5 AUMs during construction from the temporary disturbance of pasture.

3.11.6.6 No-Action Alternative

The No Action Alternative would not cause impacts on agricultural resources. The baseline conditions described in Section 3.11.5 would continue under the No Action Alternative.

3.12 Socioeconomics

3.12.1 Introduction

The socioeconomic analysis addresses potential impacts on social and economic factors during and after construction of the Proposed Action and alternatives. The focus of the analysis is on potential impacts on the retail trade, construction and farm sectors of the local economy. Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.11. The following impact topics are addressed in the analysis:

- Population
- Agricultural economics
- Gross revenue in other sectors
- Income
- Employment
- Public services and related fiscal impacts
- Housing
- Social conditions
- Growth-inducing conditions

3.12.2 Issues Eliminated From Further Analysis

None of the socioeconomic issues raised during scoping were eliminated from further analysis.

3.12.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the socioeconomic impact analysis:

- What impacts would providing pedestrian access have on increasing litter along the river?

- What economic impacts would occur to land owners who have their farmland segmented?

- How would the county tax base be affected by removing arable land from production to form a more sinuous river channel?

- What social, emotional and economic impacts would occur to property owners along the river from people trespassing, potential loss of private land by acquisition, providing public access and an influx of people pursuing recreational activities?

- What growth-inducing impacts would the Proposed Action and alternatives have on the Heber Valley?

- What social, economic and quality-of-life impacts would occur to the local communities?

- What economic impacts would be incurred by the private land owners along the river from acquisition of land for the Proposed Action and alternatives?

- What would be the socioeconomic impacts on residents of Wasatch County?

- What would be the economic impacts from repeated maintenance efforts?

- What growth-inducing impacts would the Proposed Action and alternatives have on existing land uses with increased river frontage, sensitive habitats and recreational opportunities?

- What probable economic impacts would new recreation and resource users have on Heber Valley?

3.12.4 Description of Impact Area of Influence

The socioeconomic impact area of influence includes the Provo River corridor between Jordanelle and Deer Creek reservoirs and Wasatch County. Widespread and diffuse socioeconomic impacts may occur in other areas of Wasatch County or outside the county in areas where project materials are purchased and construction workers live.

3.12.5 Affected Environment (Baseline Conditions)

The affected environment is the same as described in Section 3.12.5 of the WCWEP and DRP EIS. The types of agricultural land uses along the Provo River corridor in Heber Valley are defined in Section 3.11.

The same types of social groups described in Section 3.12.5.8 of the WCWEP and DRP EIS could be affected by the PRRP. The remainder of this section provides additional information about the concerns of farmers and land owners along the Provo River, as collected during a study for USBR and UDP&R (Bear West 1993). The results of a survey in Wasatch County related to development of new recreation opportunities also are described.

Most farmers, property owners and local residents along the Provo River are generally satisfied with the Provo River as it exists today because high flows are controlled, the channel is stable and the channelized river efficiently delivers irrigation water to diversions. Although farmers and local residents have had conflicts with people trespassing, making noise, littering and causing other problems along the river, they have generally allowed river access to serious anglers because they typically have not caused problems. Farmers and local residents are typically protective of their property, privacy and lifestyles. While many would prefer no change in the river, some land owners believe future development of some type is inevitable in the fast-growing Heber Valley. They feel their land would be worth more if it was developed for compatible uses in the future, and value change in that direction. They also are concerned about their property values and possible acquisition of private property for public use as part of the PRRP.

In a recent survey, a majority of Wasatch County residents supported continued tourism development as part of the county's economic base (CADWEST Research Consultants 1994). However, they also expressed concerns about the effects of tourism on their quality of life. For example, a majority of the property owners responding to the survey agreed that tourism growth should by managed by local government, residents' involvement in tourism decisions is important, tourism planning must take into account quality of life, and the environmental impacts of tourism are not minor.

3.12.6 Impact Analysis

3.12.6.1 Significance Criteria

The criteria for the PRRP socioeconomic analysis are the same as in Section 3.12.6.1 of the WCWEP and DRP EIS.

3.12.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential impacts were eliminated from further analysis.

3.12.6.3 Proposed Action (Riverine Habitat Restoration)

3.12.6.3.1 Population Impacts. The Proposed Action would not increase the population of the impact area of influence because it would only cause a minor increase in permanent employment opportunities and would not induce new growth for the reasons described in Section 3.12.6.3.9 of the WCWEP and DRP EIS.

3.12.6.3.2 Agricultural Economics Impacts

3.12.6.3.2.1 Gross Revenue Impacts During Construction. Impacts on farm gross revenues during construction would be caused by lands temporarily disturbed for construction access and lost revenues from lands permanently removed during construction. The acreage of grazing land and cropland temporarily and permanently disturbed during construction of the Proposed Action is shown on Table 1-10 in Chapter 1, Section 1.11.1. The related production losses are defined in Section 3.11 and the impacts on gross revenues during construction are summarized in Table 3-32. These losses of gross revenues are due to reduced grazing and crop production on lands temporarily and permanently removed from agricultural use during construction of the Proposed Action.

3.12.6.3.2.2 Gross Revenue Impacts After Construction. The Proposed Action would cause a total annual loss of approximately $8,425 in gross revenue within the entire area affected after construction from the permanent removal of grazing land and cropland (see Table 3-33). Although this loss is minor compared to total gross revenue from grazing and pasture lands in Heber Valley, it could cause a major impact on individual farm enterprises.

The Proposed Action would increase the frequency of flooding along the Provo River after construction. Periodic losses of gross revenue on inundated lands are shown on Table 3-33 for three different types of flood events. While land would be flooded for only 2 weeks or less for any flood event, more time would be needed to allow agricultural lands to dry before returning them to production. Inundated lands would likely not be usable for half of the growing season, thus reducing grazing land and cropland (irrigated pasture) yields by 50 percent. The loss of gross revenue would be minor and not significant on a regional basis. The magnitude of such impacts on individual enterprises would vary.

3.12.6.3.2.3 Production Costs. The types of impacts described in Section 3.11.6.3.3 may cause some farmers to modify their irrigation systems or farming practices. These modifications could change production costs for some farmers ifirrigation systems need to be modified, transportation routes changed or cultivation practices need to be modified. The specific impacts on individual farm enterprises would vary, are difficult to measure and were not defined in this analysis. The SOPs described in Section 1.12.9.1 of the WCWEP and DRP EIS would help avoid adverse production cost impacts on individual farmers and land owners. Most modifications and repairs would be completed by the project during construction.

3.12.6.3.3 Gross Revenue Impacts in Other Sectors. Tables 3-32 and 3-33 show potential gross revenue impacts of the Proposed Action. Construction and retail trade gross revenue would increase during construction as contractors purchase materials and construction workers purchase gasoline and food. A total of about $418,000 would be paid to one or more local companies to haul away and dispose of rock, soil and other waste material during construction. This would be a peak annual increase of about $60,000. The gross revenue from local sales of building materials would be negligible. Table 3-32 includes the projected increases in retail trade gross revenues during construction of the Proposed Action. The peak annual increase in retail trade gross revenues is expected to be $24,000, primarily due to gasoline and food purchased by construction workers. The total increase in retail trade gross revenues during construction is expected to be $119,000.

Retail trade gross revenue would increase after construction as more recreationists visit the Provo River corridor. The expected increase in recreation use under the Proposed Action would be 9,240 angler days per year. Expenditures by recreationists would increase Heber Valley retail trade gross revenue by about $85,000 per year. This assumes that 50 percent of the increase in angler days generate expenditures in Wasatch County of $18.40 per angler day. It was further assumed the recreationists would not spend the night in Heber Valley.

3.12.6.3.4 Total Gross Revenue Impacts. Impacts of the Proposed Action on the retail trade, construction and farm sectors would increase regional gross revenue. Gross revenue is expected to increase in Wasatch County during and after construction of the Proposed Action. During construction, the peak annual increase in total gross revenue in Wasatch County would be approximately $84,000, or less than 1 percent. Total gross revenues over the construction period would increase approximately $179,000. The minor decrease in agricultural revenue (see Table 3-32) would be even smaller on a peak annual basis, but

Table 3-32
Socioeconomic Impacts During Construction of the Proposed Action and Alternatives

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Impact Topic	Proposed Action	Existing Channel Modification Alternative	Instream Structures Alternative
AGRICULTURAL GROSS REVENUE[1] LOST FROM GRAZING LAND AND CROPLAND (in dollars)			
Temporary Land Disturbance	(442)	(32)	(32)
Permanent Land Removal	(8,420)	(346)	(0)
Total Loss	(8,862)	(378)	(32)
GROSS PEAK ANNUAL REVENUE IN RETAIL TRADE SECTOR (in dollars)			
Baseline Retail Trade Sector Revenue[2,3]	70,453,000	70,453,000	70,453,000
Revenue With Proposed Action and Alternatives[4]	70,477,000	70,483,000	70,457,000
Increase	24,000	30,000	4,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
GROSS PEAK ANNUAL REVENUE IN CONSTRUCTION SECTOR (in dollars)			
Baseline Construction Sector Revenue[2,3]	6,000,000	6,000,000	6,000,000
Revenue With Proposed Action and Alternatives	6,060,000	6,047,000	6,000,000
Increase	60,000	47,000	0
Percent Change	**+1.0 %**	**< 1.0 %**	**0 %**
TOTAL GROSS PEAK ANNUAL REVENUE IN WASATCH COUNTY (in dollars)			
Baseline Wasatch County Gross Revenue[2,3]	120,673,000	120,673,000	120,673,000
Revenue With Proposed Action and Alternatives	120,757,000	120,750,000	120,677,000
Increase	84,000	77,000	4,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
PEAK ANNUAL INCOME IMPACTS WITHIN SECTORS (in dollars)			
Baseline Construction Sector Income[2,3]	21,108,000	21,108,000	21,108,000
Income With Proposed Action and Alternatives	21,666,000	21,689,000	21,197,000
Increase	558,000	581,000	89,000
Percent Change	**+2.6 %**	**+2.8 %**	**< 1.0 %**
Baseline Retail Trade Sector Income[2,3]	12,168,000	12,168,000	12,168,000
Income With Proposed Action and Alternatives[4]	12,173,000	12,174,000	12,168,000
Increase	5,000	6,000	0
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**

Table 3-32
Socioeconomic Impacts During Construction of the Proposed Action and Alternatives

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Impact Topic	Proposed Action	Existing Channel Modification Alternative	Instream Structures Alternative
Baseline Farm Sector Income	3,000,000	3,000,000	3,000,000
Income With Proposed Action and Alternatives	2,998,000	3,000,000	3,000,000
Decrease	(2,000)	0	0
Percent Change	**< 1.0 %**	**0 %**	**0 %**
TOTAL PEAK ANNUAL INCOME IN WASATCH COUNTY			
Baseline Total Income in Wasatch County[2,3]	116,366,000	116,366,000	116,366,000
Total Income With Proposed Action and Alternatives	116,927,000	116,953,000	116,455,000
Increase	561,000	587,000	89,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
PEAK EMPLOYMENT (Jobs)			
Construction Sector	**25**	25	6

Notes:

[1] Gross revenue is income from sales without considering costs associated with production
[2] Source: State of Utah Department of Employment Security 1995b
[3] Source: U.S. Bureau of Economic Analysis 1994
[4] Reflects changes in income to materials suppliers, gasoline retailers, and retail businesses

Table 3-33
Socioeconomic Impacts After Construction of the Proposed Action and Alternatives

Page 1 of 2

Impact Topic	Proposed Action	Existing Channel Modification Alternative	Instream Structures Alternative
AGRICULTURAL GROSS REVENUE[1] LOST FROM GRAZING LAND AND CROPLAND (in dollars)			
Annual Loss of Revenue from Permanent Land Removal	(8,425)	(346)	0
Periodic Loss from Flood Inundation 2-Year Event	(493)	0	0
10-Year Event	(978)	0	0
100-Year Event	(4,912)	0	0
GROSS ANNUAL REVENUE IN RETAIL TRADE SECTOR (in dollars)			
Baseline Retail Trade Sector Revenue[2,3]	70,453,000	70,453,000	70,453,000
Revenue With Proposed Action and Alternatives[4]	70,538,000	70,479,000	70,463,000
Increase	85,000	26,000	10,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
TOTAL GROSS ANNUAL REVENUE IN WASATCH COUNTY (in dollars)			
Baseline Total Gross Revenue in Wasatch County[2,3]	120,673,000	120,673,000	120,673,000
Total Revenue With Proposed Action and Alternatives	120,752,000	120,699,000	120,681,000
Increase	79,000	26,000	8,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
ANNUAL INCOME IMPACTS WITHIN SECTORS (annual)			
Baseline Retail Trade Sector Income[2,3]	12,168,000	12,168,000	12,168,000
Income With Proposed Action and Alternatives[4]	12,183,000	12,172,000	12,169,000
Increase	15,000	5,000	1,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
Baseline Farm Sector Income	3,000,000	3,000,000	3,000,000
Income With Proposed Action and Alternatives	2,999,000	3,000,000	3,000,000
Decrease	(1,000)	0	0
Percent Change	**< 1.0 %**	**0 %**	**0 %**

Table 3-33
Socioeconomic Impacts After Construction of the Proposed Action and Alternatives
Page 2 of 2

Impact Topic	Proposed Action	Existing Channel Modification Alternative	Instream Structures Alternative
TOTAL ANNUAL INCOME IN WASATCH COUNTY			
Baseline Total Income in Wasatch County[2,3]	116,366,000	116,366,000	116,366,000
Income With Proposed Action and Alternatives	116,380,000	116,370,000	116,369,000
Increase	14,000	4,000	3,000
Percent Change	**< 1.0 %**	**< 1.0 %**	**< 1.0 %**
EMPLOYMENT (Jobs)			
Baseline Retail Trade Sector Jobs[2,3]	1,306	1,306	1,306
Jobs With Proposed Action and Alternatives	1,310	1,307	1,306
Increase	4	1	0
Percent Change	**<1.0 %**	**<1.0 %**	**0.0 %**
Baseline Wasatch County Employment[2,3]	7,846	7,846	7,846
Jobs With Proposed Action and Alternatives	7,850	7,847	7,846
Increase	4	1	0
Percent Change	**<1.0 %**	**<1.0 %**	**0.0 %**

Notes:

[1] Gross revenue is income from sales without considering costs associated with production
[2] Source: State of Utah Department of Employment Security 1995b
[3] Source: U.S. Bureau of Economic Analysis 1994
[4] Reflects changes in income to materials suppliers, gasoline retailers, and retail businesses

would reduce the peak annual increase in total county revenue by a small amount.

3.12.6.3.5 Income Impacts Within Sectors. Tables 3-32 and 3-33 show potential income impacts. During construction, the impacts on revenue described in Sections 3.12.6.3.2.1 and 3.12.6.3.3 would decrease income in the farm sector and increase revenue in the retail trade and construction sectors.

After construction, retail trade income would increase as recreationists are attracted to the Provo River. This is projected to increase Heber Valley retail trade income by about $15,000 a year. Farm income is expected to decrease slightly due to land permanently removed from agricultural production and periodic flood events.

3.12.6.3.6 Total Income Impacts. During construction of the Proposed Action, the peak annual increase in total Wasatch County income would be about $561,000, or less than a 1 percent increase. This includes a peak annual expenditure of $1,631,000 to acquire land and easements along the Provo River. The total acquisition cost would be about $6,524,000. Total Wasatch County income would increase by approximately $14,000 a year after construction, less than 1 percent of total annual income. The increase in retail trade income after construction would be larger than the decrease in farm sector income.

Property values along the Provo River would likely increase as fishing improves, wildlife habitat is enhanced, and views of the river corridor from properties improve. This would increase income for those that sell their land after values increase. This type of impact is difficult to quantify and is not included in the income estimates in Tables 3-32 and 3-33.

3.12.6.3.7 Employment Impacts. About 25 temporary jobs would be created during construction of the Proposed Action, and four our part-time workers would be needed to maintain the Provo River corridor after construction. About eight new retail jobs would be created in Heber Valley after construction —less than a 1 percent increase in Wasatch County's permanent retail trade sector employment.

472 **3.12.6.3.8 Public Services and Related Fiscal Impacts.** The Mitigation Commission would ensure that maintenance of the public access corridor established under baseline conditions occurs without adversely impacting the fiscal resources of local agencies. The Mitigation Commission would likely contract with an administrative entity that would maintain restroom facilities, remove trash, etc. This type of contract would continue under the Proposed Action.

The increase in gross revenue during construction would increase local and state sales tax revenue by about $5,000. The actual increase would be slightly lower than the small drop in agricultural tax revenue. After construction, the increase in gross revenue would increase both local and state sales tax revenue by about $2,000 a year. State and federal income tax revenue also would increase as income rises.

Approximately 284.2 acres of land would be acquired under the Proposed Action (see Table 1-11 in PRRP EIS Chapter 1). Federal payments in lieu of taxes would begin for these acquired lands assuming Wasatch County is still eligible for such payments when the lands are acquired. Assuming the payments are $1.11 per acre per year (BLM 1996), the net decrease in property tax revenue would be about $104,407 per year. This analysis uses a worst-case approach by assuming all land is acquired by fee title instead of easements. A separate and minor increase in property tax revenues could occur if the amenities of the Proposed Action increase property values along the Provo River.

There would be a minor impact on crime prevention services in the impact area of influence. A greater increase in crime along the river would occur before the Proposed Action is constructed under baseline conditions (new public access points and contiguous public access along the river will be provided under baseline conditions before the Proposed Action and alternatives are constructed).

3.12.6.3.9 Growth-Inducing Impacts. The Proposed Action would not induce additional growth in Heber Valley for the same reasons defined in Section 3.12.6.3.9 of the WCWEP and DRP EIS.

3.12.6.3.10 Social Impacts. The following subsections present the social impacts of the Proposed Action.

3.12.6.3.10.1 Farmers and Their Employees. Most farmers and their employees along the Provo River would likely be upset by temporary and permanent disturbances to their operations and adverse noise, visual and dust impacts during construction. Operations and future plans of some farmers may be affected by permanent removal of land and fencing for the new river channel and side channels. As noted in Section 3.11.6 of this EIS, some individual farm enterprises may experience adverse impacts on agricultural practices and operations. Some farmers and their employees also may be annoyed by fishermen who trespass and litter on agricultural lands along the Provo River corridor. After construction, the reduction in income associated with permanent removal of agricultural land could have a negative impact on their disposable incomes and lifestyles. Some of these impacts on the lifestyles, values and attitudes of farmers could be significant during and after construction. The SOPs described in Section 1.12.9.1 of the WCWEP and DRP EIS would help reduce the magnitude of these impacts.

3.12.6.3.10.2 Other Local Business Owners and Their Employees. Construction and retail trade gross revenue would increase during construction as contractors purchase materials and haul waste material from construction sites and construction workers purchase gasoline and food. Additional recreationists visiting Heber Valley also would raise the income of local business owners and their employees as purchases of food, gasoline, sporting goods and other items increase. This would cause a positive impact on the disposable incomes and lifestyles of affected business owners and their employees.

3.12.6.3.10.3 Local Residents and Property Owners. Some property owners and residents along the Provo River would experience significant and adverse social impacts during and after construction of the Proposed Action, while others would experience positive impacts. Those who would be negatively affected would be upset by such nuisances as noise, dust and traffic impacts. Some would be required to sell portions of their property or provide temporary easements for construction access. Unwilling sellers would resent imposition and control by others on their property rights and their sense of independence. Some residents and property owners would be adversely affected by fishermen who trespass, litter or even vandalize their property or cause other nuisances. Future development plans of some property owners may be altered by fencing or land-use restrictions.

Beneficial impacts would accrue to local residents who are employed to help construct the Proposed Action. The income of property owners along the Provo River would increase as lands and/or easements are acquired during construction. After construction, some local residents and property owners would experience direct or indirect increases in income and employment opportunities, especially in retail trade. Property owners along the Provo River may benefit from increased property values.

3.12.6.3.10.4 Recreationists and Conservationists. Recreationists and conservationists would be mostly satisfied with the Proposed Action for the same reasons described in Section 3.12.6.3.10.4 of the WCWEP and DRP EIS.

3.12.6.3.10.5 Community Well-Being. There could be an increase in conflicts among social groups as some farmers, residents or property owners experience the negative impacts described above. After construction, there could be conflicts between recreationists and local residents and farmers. However, the intensity of such conflicts would likely be too minor from a regional, community-wide perspective to significantly affect community cohesion and stability.

3.12.6.3.11 Impact Summary. Some farmers and their employees, local residents and property owners would experience significant and adverse social impacts during and after construction of the Proposed Action. Positive employment and income impacts would occur during construction in the construction and retail trade sectors of the economy and for some people directly and indirectly affected, including local business owners, their employees and some local residents. After construction, the Proposed Action is expected to benefit recreationists and cause an increase in revenue and income for the owners and employees of businesses that would serve recreationists. The decrease in agricultural revenue caused by the Proposed Action would be less than the increase in revenue of other sectors, both during and after construction. The potential reduction in property tax revenue caused by the Proposed Action would be a negative impact on the fiscal resources of Wasatch County.

3.12.6.4 Existing Channel Modification Alternative

Tables 3-32 and 3-33 summarize the major socioeconomic impacts of the Existing Channel Modification Alternative.

3.12.6.4.1 Population Impacts. This alternative would not increase the population of Heber Valley because it would only cause a minor increase in permanent employment opportunities.

3.12.6.4.2 Agricultural Economics Impacts. This alternative would cause very minor impacts on farm revenue during and after construction (see Tables 3-32 and 3-33) as a small amount of agricultural land is temporarily and permanently disturbed. It would not increase flooding on agricultural lands along the Provo River.

3.12.6.4.3 Gross Revenue Impacts in Other Sectors. Construction of this alternative would increase revenue in the construction and retail trade sectors, including the expenditure of about $237,000 for hauling and disposal of waste material. Revenue also would increase in the retail trade sector after construction as recreation use and expenditures increase. The recreation analysis in Section 3.16 concluded recreation use along the Provo River would increase by about 2,836 angler days a year under this alternative.

3.12.6.4.4 Total Gross Revenue Impacts. Total gross revenue in Wasatch County would increase during and after construction. The increases would be minor from a regional perspective, i.e. less than 1 percent of total county revenue.

3.12.6.4.5 Sector and Total Income Impacts. This alternative would cause the same type of income impacts as the Proposed Action in Sections 3.12.6.4.5 and 3.12.6.4.6. The magnitude of the impacts would be smaller, as shown in Tables 3-32 and 3-33.

3.12.6.4.6 Employment Impacts. About 25 temporary jobs would be created during construction of this alternative. After construction, only one part-time worker would be needed to maintain the Provo River corridor, and there would be a slight increase in employment in Heber Valley from the increase in retail trade income.

3.12.6.4.7 Public Services and Related Fiscal Impacts. The impacts on public services and fiscal resources under this alternative would be similar to those described in Section 3.12.6.3.8, although less tax revenue would be generated. The increase in both local and state sales tax revenue would be about $5,000 during construction, and about $1,500 a year after construction.

Approximately 7.6 acres of land would be acquired under the Existing Channel Modification Alternative (see Table 1-10 in PRRP EIS Chapter 1). Federal payments in lieu of taxes would begin for these acquired lands, assuming Wasatch County is still eligible for such payments when the Proposed Action is constructed. Assuming the payments are $1.11 per acre per year (BLM 1996), and all land is acquired by fee title, the net decrease in property tax revenue would be about $2,791 per year.

3.12.6.4.8 Growth-Inducing Impacts. This alternative would not induce growth for the same reasons defined in Section 3.12.6.3.9 of the WCWEP and DRP EIS.

3.12.6.4.9 Social Impacts. The social impacts of this alternative would be similar to but of less significance than those described in Section 3.12.6.4.10. Less land would be temporarily and permanently disturbed, and fewer recreationists would visit the area after construction.

3.12.6.4.10 Impact Summary. The same type of impacts described in the summary in Section 3.12.6.3.11 also would occur under this alternative, except farmers, local residents, and property owners would not experience significant and adverse social impacts.

3.12.6.5 Instream Structures Alternative

Tables 3-32 and 3-33 summarize the major socioeconomic impacts of the Instream Structures Alternative.

3.12.6.5.1 Population Impacts. This alternative would not increase the population of Heber Valley because it would only cause a minor increase in permanent employment opportunities.

3.12.6.5.2 Agricultural Economics Impacts. This alternative would cause negligible impacts on farm revenue during construction (see Tables 3-32 and 3-33) as a small amount of agricultural land is temporarily disturbed. It would not impact agricultural lands after construction.

3.12.6.5.3 Gross Revenue Impacts in Other Sectors. Construction of this alternative would cause a minor revenue increase in the construction sector. Revenue would increase in the retail trade sector after construction as recreation use and expenditures increase. The recreation analysis in Section 3.16 concluded recreation use along the Provo River would increase by about 1,104 angler days a year under this alternative.

3.12.6.5.4 Total Gross Revenue Impacts. Total gross revenue in Wasatch County would increase during and after construction. The increases would be minor from a regional perspective, i.e. less than 1 percent of total county revenue.

3.12.6.5.5 Sector and Total Income Impacts. This alternative would cause the same type of income impacts as the Proposed Action and described in Sections 3.12.6.4.5 and 3.12.6.4.6. The magnitude of the impacts would be notably smaller, as shown in Tables 3-32 and 3-33.

3.12.6.5.6 Employment Impacts. About six temporary jobs would be created during construction of this alternative and no employment opportunities would be created after construction.

3.12.6.5.7 Public Services and Related Fiscal Impacts. The impacts on public services and fiscal resources under this alternative would be similar to those described in Section 3.12.6.3.8, but less tax revenue would be generated. The increase in local and state sales tax revenue would be less than $1,000 during and after construction. Since land would not need to be acquired under the Instream Structures Alternative, related impacts on property tax revenues would not occur.

3.12.6.5.8 Growth-Inducing Impacts. This alternative would not induce for the same reasons defined in Section 3.12.6.3.9 of the WCWEP and DRP EIS.

3.12.6.5.9 Social Impacts. The social impacts of this alternative would be similar to and less than those described in Section 3.12.6.4.10. Less land would be temporarily and permanently disturbed, and fewer recreationists would visit the area after construction.

3.12.6.5.10 Impact Summary. The same type of impacts summarized in Section 3.12.6.3.11 also would occur under this alternative, except it would not cause adverse agricultural economic impacts after construction. The Instream Structures Alternative also would not cause significant and adverse social impacts.

3.12.6.6 No Action Alternative

The No Action Alternative would not cause socioeconomic impacts because baseline socioeconomic conditions would continue. The initial impacts of acquiring a public access corridor along the Provo River would occur under baseline conditions to meet the commitments described in Section 1.11 of the WCWEP and DRP EIS. These impacts would continue under the No Action Alternative.

3.13 Health and Safety

3.13.1 Introduction

The health and safety analysis addresses potential public safety hazards and health risks during and after construction of the Proposed Action and alternatives. The methodology used to conduct the health and safety analysis is described in Appendix B, Section B.3.12. The following impact topics are addressed in the analysis:

- Health and safety hazards during construction
- Hazards related to flooding along the Provo River

3.13.2 Issues Eliminated From Further Analysis

The following issues were raised during scoping and eliminated from further analysis:

- What would be the flooding impact of the PRRP if Jordanelle Dam spills more water than the reconstructed channel capacity?
- What would be the flood-related impacts on public safety from breaching existing dikes?

The Proposed Action and alternatives have been designed to contain 100-year flood events within their dikes, consistent with standard engineering practices. The existing dike system along the Provo River also is designed to contain 100-year flood events. It is very unlikely that future flooding along the river and spills at Jordanelle Dam will exceed the flooding and spills associated with a 100-year event. Jordanelle Dam and Reservoir — and its spillway — were designed to handle the "Probable Maximum Flood" (PMF) event for the watershed. The PMF would occur no more than about once every 1,000 years, based on historic hydrology. If future spills and flooding exceed 100-year event levels, Provo River flows may cause flooding outside the 100-year floodplain and the dikes included in the Proposed Action and alternatives may be breached. This unlikely event would not be an impact of the Proposed Action and alternatives since they have been designed to provide the same level of flood protection that typically occurs under baseline conditions, and they would not affect the operation or capacity of Jordanelle Reservoir. This EIS only assesses the potential impacts of the Proposed Action and alternatives.

3.13.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and addressed in the health and safety impact analysis:

- How would PRRP construction activities affect public health and safety?
- Would the Provo River cause flooding-related public safety hazards?

3.13.4 Description of Impact Area of Influence

The impact area of influence for the health and safety analysis includes areas along the Provo River where the Proposed Action and alternatives would be constructed and where flooding would occur after construction. It also includes roads used by construction and recreation traffic (Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence.

3.13.5 Affected Environment (Baseline Conditions)

Traffic-related hazards, especially on and near Highways 40, 113 and 189 in Heber Valley, are the most notable public safety hazards under baseline conditions. Schools, residences and many businesses are adjacent to or near these highways.

The existing dike system along the Provo River contains flood events up to and including 100-year events. No flooding occurs from the river in areas outside the dikes. Most of the land within the impact area of influence is not inhabited or regularly used by people.

3.13.6 Impact Analysis

3.13.6.1 Significance Criteria

Any increase in the risk of flooding compared to baseline conditions (i.e., flooding greater than that associated with 100-year flood events) is considered significant.

Health and safety hazards during construction are considered significant if procedures and SOPs would not minimize the risks of accidents to acceptable levels that are typical of projects of this type.

3.13.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential impacts identified during scoping have been eliminated from further analysis.

3.13.6.3 Proposed Action (Riverine Habitat Restoration)

3.13.6.3.1 Construction Hazards. Construction of the Proposed Action would have the same potential hazard impacts as described in Section 3.13.6.3.1 of the WCWEP and DRP EIS. However, the Proposed Action would not require the flood-abatement provisions for work areas.

3.13.6.3.2 Hazards Related to Flooding. The Proposed Action would increase the frequency of flooding and the size of the floodplain along the Provo River, but there would be very little risk to people since flooding would be contained by dikes and the riparian corridor would be fenced. The operators of Jordanelle Reservoir would know when flooding would occur at least a week in advance. The highest releases and spills would be gradual, taking about a day to rise to peak levels, peaking for about an hour, and then taking a day to recede. The risk to fishermen and other recreationists inside the fenced and diked riparian corridor would be minimal since there would be plenty of time to avoid rising waters.

3.13.6.3.3 Other Hazards After Construction. There would be a slight increase in the risk of traffic accidents along Highways 40, 189, 113 and River Road where the Proposed Action would cause an increase in recreation-related traffic. The Proposed Action would increase the number of recreationists and children visiting the river. Therefore, the risk of such water-related hazards as drowning would increase.

3.13.6.3.4 Impact Summary. There would be a minor risk of increased traffic accidents for motorists driving near construction traffic and when recreation-related traffic increases after construction. However, the SOPs included in the Proposed Action would adequately reduce the risk for workers and the general public during construction. The Proposed Action would increase the frequency of flooding and drowning along the Provo River but flooding would be contained within dikes. None of these impacts would be significant.

3.13.6.4 Existing Channel Modification Alternative

3.13.6.4.1 Construction Hazards.. Construction hazards and related SOPs under this alternative are the same as described in Section 3.13.6.3.1 of the WCWEP and DRP EIS. However, this alternative would not require the flood-abatement provisions for work areas.

3.13.6.4.2 Hazards Related to Flooding. This alternative would increase the frequency of flooding along the Provo River, but would contain floodwaters within the dikes constructed as part of the alternative. Risks to people would be minimal for the same reasons described in Section 3.13.6.3.2.

3.13.6.4.3 Other Hazards After Construction. The minor increase in traffic accident risks under this alternative would be the same as described in Section 3.13.6.3.3.

3.13.6.4.4 Impact Summary. The impact summary for this alternative is the same as in Section 3.13.6.3.4.

3.13.6.5 Instream Structures Alternative

Potential health and safety impacts for this alternative would be the same as described for the Proposed Action in Section 3.13.6.3, except this alternative would not increase the frequency of flooding along the Provo River because the river channel would not be modified.

3.13.6.6 No Action Alternative

The No Action Alternative would have no impacts on health and safety. Baseline conditions would continue as described in Section 3.13.5 under the No Action Alternative.

3.14 Noise

3.14.1 Introduction

This noise analysis addresses potential impacts from the construction activities and resulting recreation traffic of the Provo River Restoration Project. The methodology used to conduct the noise analysis is defined in Appendix B, Section B.3.13. The following noise topics are addressed in the impact analysis

- Noise from construction activities
- Noise after construction, i.e., from recreation traffic generated by the Proposed Action and alternatives

3.14.2 Issues Eliminated From Further Analysis

None of the noise issues identified during scoping and defined in Section 3.14.3 were eliminated from further analysis.

3.14.3 Issues Addressed in the Impact Analysis

The following issues were raised in scoping and are addressed in the noise impact analysis:

- Would construction of the Proposed Action and alternatives increase noise levels in Heber Valley?
- Would the recreation traffic and increase in recreation use caused by the Proposed Action and alternatives increase noise levels?

3.14.4 Description of Impact Area of Influence

The impact area of influence for the noise analysis includes areas where noise generated by the Proposed Action and alternatives would be heard. Noise would be generated from Heber Valley roads used by construction and recreation traffic and areas along the Provo River where construction activities would occur. Map 3-1 in Section 3.1.1.1 shows the overall impact area of influence.

3.14.5 Affected Environment (Baseline Conditions)

Noise is measured using the A-weighted decibel scale (dBA). Values on this scale represent the loudness of common sounds perceived by humans.

Quantified noise data were not available to help define baseline noise conditions in the impact area of influence. However, some general conclusions can be reached based on field visits and published noise studies (CEQ 1970 and Urban Institute 1976). Heber Valley is generally a quiet valley except for noise generated by traffic on roads, especially Highways 40, 113 and 189 and River Road. Highway traffic typically generates noise at about 70 dBA with large trucks generating noise up to 90 dBA. These decibel ratings are at a distance of 50 feet, the standard reference distance used in noise studies. Noise from these sources is reduced as the distance from the source increases. A doubling in distance reduces decibel ratings by a factor of four, if there are no other mitigating factors such as trees, walls and other physical barriers.

The only sensitive noise receptors near PRRP construction sites are isolated residences on large lots in rural areas near the Provo River (sensitive noise receptors are locations especially susceptible to noise impacts, such as schools, hospitals, nursing homes and residences). There are some sensitive noise receptors in the central portion of Heber City, including four schools, a hospital and nursing home. None of these are adjacent to Highways 40 and 189.

3.14.6 Impact Analysis

3.14.6.1 Significance Criteria

The noise criteria used to assess the PRRP Proposed Action and alternatives are the same as described in Section 3.14.6.1 of the WCWEP and DRP part of this EIS.

3.14.6.2 Potential Impacts Eliminated From Further Analysis

All of the noise issues identified during scoping were addressed in the impact analysis.

3.14.6.3 Proposed Action (Riverine Habitat Restoration)

3.14.6.3.1 Noise Related to Construction Activities. Noise would be generated by vehicles and equipment used to construct the Proposed Action would generate noise. Construction activities would require using such equipment as compactors, bulldozers, loaders, excavators, scrapers and various types of trucks. Typical noise levels of this equipment at 50 feet are defined in Table 1-10 of WCWEP and DRP EIS Chapter 1. The loudest equipment are compactors, bulldozers and loaders (up to 96 dBA at 50 feet), and motor graders and scrapers (up to 95 dBA at 50 feet). Most of this equipment would be confined to construction sites in the Provo River corridor, except for trucks used to haul waste material on Highways 40, 113 and 189 and the smaller roads near construction sites. These types of trucks usually generate noise levels of 70 to 92 dBA at 50 feet.

Some sensitive noise receptors would be near construction sites, i.e., isolated residences near the Provo River corridor. Some residents and pedestrians near construction sites would experience significant and adverse noise impacts during construction Some noise levels would exceed the significance criteria (74 to 88 dBA) for people within about 50 feet of construction sites. Lower noise levels would be experienced by people farther away. Lower noise levels would be experienced by people farther away. The noise impacts would occur during the day for approximately 8 to 10 hours, five days a week throughout the duration of construction.

Baseline noise levels along Highways 40, 113 and 189 include noise from large trucks that typically generate about 70 to 90 dBA. None of the sensitive noise receptors in Heber City are adjacent to Highway 40 or 189, and the noise level from trucks hauling waste material during construction would likely be the same as emitted by large trucks under baseline conditions. Although the frequency of truck noise on the highways would increase until the waste hauling is completed, the noise levels would not be significant for sensitive receptors along highways.

Some of the hauling of waste material would occur on smaller roads in Heber Valley. Significant noise impacts could occur on and near roads that are not used by large trucks under baseline conditions. Residents, drivers, pedestrians, bicyclists and joggers on and along these roads would experience significant noise impacts as haul trucks drive by.

3.14.6.3.2 Noise After Construction. The Proposed Action would require very little maintenance, and noise after construction would primarily be generated by recreationists.

Recreation traffic would increase noise levels on and along the roads used by recreationists attracted to the improved fishing and other recreation opportunities along the Provo River. The level would likely be the same as traffic under baseline conditions (up to 70 dBA), which falls below the “unacceptable” level of 74 dBA and above. The frequency of noise impacts along the roads would increase as traffic increases.

New recreationists would increase noise levels along the Provo River, especially at and near the seven new recreation access points.

3.14.6.3.3 Impact Summary. The Proposed Action would generate noise levels that exceed the significance criterion for people within about 50 feet of construction sites. Some people would experience significant noise impacts during construction along smaller roads in the impact area of influence that are not traveled by large trucks under baseline conditions. Additional noise impacts would occur along roads from recreation traffic and from recreationists along the Provo River.

3.14.6.4 Existing Channel Modification Alternative

The Existing Channel Modification Alternative would cause the same noise impacts as described for the Proposed Action in Section 3.14.6.3. However, the location of some of the impacts and the people affected by them would be different in some cases since the Proposed Action would include modifying the river channel in areas where no construction would occur under this alternative. This would cause the same types of impacts, but some residents and others would be affected differently because their distance from the noise source would vary.

3.14.6.5 Instream Structures Alternative

The Instream Structures Alternative would cause the same types of noise impacts as described for the Proposed Action in Section 3.14.6.3. However, the potential for significant impacts would be reduced because less equipment and fewer vehicles would be necessary (only backhoes, dozers and excavators would be required). This type of construction equipment would have the potential to cause significant impacts for residents and others close to construction sites. The impacts would occur in the same location as the impacts of the Existing Channel Modification Alternative.

3.14.6.6 No Action Alternative

The No Action Alternative would have no noise impacts. Baseline conditions would continue as described in Section 3.14.5 under the No Action Alternative.

3.15 Visual Resources

3.15.1 Introduction

The visual analysis addresses potential impacts on visual resources from construction of the Proposed Action and alternatives. The focus of the analysis is on potential visual impacts visible from three critical viewpoints: Highway 40 looking south over the Heber Valley, Valley Hills Subdivision and Memorial Hill. The visual analysis methodology is presented in Appendix B, Section B.3.14. The visual resource discipline addresses potential impacts to the following impact topics:

- Views from critical viewpoints focusing on middle-ground and background views
- Changes in existing landscape character attributes

3.15.2 Issues Eliminated From Further Analysis

None of the visual issues raised during scoping and listed in Section 3.15.3 have been eliminated from further analysis.

3.15.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What visual impacts would occur from the Provo River Restoration Project? How would these visual impacts be mitigated?
- How would the PRRP change the visual character of the Provo River and its riparian corridor?

3.15.4 Description of Impact Area of Influence

The visual impact area of influence consists of about 10 miles of the Provo River corridor between Jordanelle Dam and Deer Creek Reservoir. The corridor width that would be affected during construction and development of the PRRP extends about 1,500 feet on either side of the existing channel. Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence and includes the nine PRRP reaches.

3.15.5 Affected Environment (Baseline Conditions)

The Provo River bisects the picturesque Heber Valley between Jordanelle and Deer Creek reservoirs. The river is easy to identify visually from the three critical viewpoints because of the distinct riparian woodland vegetation growing along its banks. The channelized river alignment and constructed dikes are obvious in the foreground from the Memorial Hill viewpoint. Reach 4, as seen from Memorial Hill and Valley Hills Subdivision, is the most natural looking reach because there are no dikes, and riparian vegetation is most extensive in this reach. The valley adjacent to the river corridor is primarily an open agricultural area. Some residential development has occurred on large lots adjacent to the Provo River corridor.

The visual character of Provo River corridor changes with the seasons as trees leaf out in the spring, turn color, then loose foliage in the fall. The valley and adjacent mountains are covered with snow during some winter months. These seasonal changes are dependent on the color and texture of existing vegetation.

3.15.6 Impact Analysis

3.15.6.1 Significance Criteria

Significance criteria for the Proposed Action and alternatives are the same as described in Section 3.15.6.1 of the WCWEP and DRP EIS.

3.15.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential visual impacts have been eliminated from further analysis.

3.15.6.3 Proposed Action (Riverine Habitat Restoration)

3.15.6.3.1 Visual Impacts Viewed From Highway 40. Visual impacts that would occur in the upper five river reaches (Reaches 5-9) would be most visible from this viewpoint in the middle ground and background distance zones. Construction of the new river channel, new setback dikes and floodplain grading would temporarily remove more than 100 acres of vegetated land along the river corridor, altering the visual texture, color, line and landform of the landscape and resulting in short-term, adverse visual impacts. About 997 mature cottonwood trees would be permanently removed in Reaches 5-9, causing adverse visual impacts from contrasts with existing visual line, landform, texture and color.

Construction of the new river channel under the Proposed Action would permanently change the character of the river from a straight line to a more natural-looking, sinuous river with a wider, irregular riparian corridor. This would result in significant long-term visual improvements that would be very noticeable from Highway 40 because of the direct view and elevation above the valley. Expansion of the riparian vegetation would add pleasing color, texture and an irregular vegetation boundary to the landscape.

3.15.6.3.2 Visual Impacts Viewed From Valley Hills Subdivision. The nine river reaches are visible in the background distance zone from this viewpoint. Construction of the new channel under the Proposed Action would remove more than 100 acres of existing riparian woodland, shrub and meadow vegetation and permanently remove mature cottonwoods adjacent to the river corridor, resulting in short-term, adverse visual impacts visible from the critical viewpoint in Valley Hills subdivision. Removal of existing vegetation would alter the visual line, form, texture and color in the landscape, adversely impacting the visual quality of Heber Valley during the short-term.

However, the channel realignment associated with the Proposed Action also would create long-term visual improvements from this viewpoint, most notably the expansion of riparian vegetation along the Provo River compared to baseline conditions, which would enhance color, texture and irregular line qualities in the visual landscape. The visual improvement from would be less noticeable from the Valley Hills viewpoint than from Highway 40 because the view angle is perpendicular to the river and the viewpoint is lower in elevation than the Highway 40 viewpoint.

3.15.6.3.3 Visual Impacts Viewed From Memorial Hill. All nine river reaches also are visible from this viewpoint, but Reaches 3-6 are viewed in the foreground and middle ground, making disturbance and alignment changes more noticeable in these reaches. More than 100 acres of land along the river corridor would be temporarily disturbed by construction of the new channel, setback dikes and floodplain grading, resulting in short-term, adverse visual impacts caused by disturbed soils and vegetation removal. More than 447 mature cottonwood trees would be permanently removed in Reaches 3-6, altering the visual line, form texture and color in the landscape.

Long-term visual improvements resulting from the channel realignment would be more noticeable from this viewpoint because of the close proximity and elevation above the river. It would take 15 to 30 years to establish a well defined riparian zone along the river corridor, but the riparian corridor would be expanded and more diverse than it is today. The channel realignment would result in a significant visual improvement in Reaches 3, 5 and 6 from this viewpoint.

3.15.6.3.4 Impact Summary. Short-term visual impacts from removal of existing vegetation would be reduced as riparian vegetation becomes established. Permanent visual improvements would result from the realignment of the existing channel and establishment of a diverse vegetated riparian corridor. Visual impacts and improvements would be related to color, texture, landform and line in the landscape.

3.15.6.4 Existing Channel Modification Alternative

3.15.6.4.1 Visual Impacts Viewed From Highway 40. More than 75 acres of vegetated land adjacent to the Provo River would be temporarily disturbed by modifications to the existing river channel, removal of existing dikes, construction of new setback dikes and new floodplain construction, resulting in short-term, adverse visual impacts. These short-term impacts would consist of changes in color, texture and landform from removal of vegetation, soil disturbance and land grading viewed mostly from the background distance. More than 1,080 mature cottonwood trees would be permanently removed, altering the visual line, texture and color in the landscape. New 2-foot-high setback dikes would be constructed in some locations at the edge of the new floodplain, creating a new landform, line and color in the landscape and causing short-term visual impacts. However, the visual impacts would less significant from this viewpoint as vegetation becomes established on the dikes and a well defined riparian zone emerges along the river corridor in 15 to 30 years. These long-term visual improvements would enhance the color, texture and irregular vegetation boundary lines.

3.15.6.4.2 Visual Impacts Viewed From Valley Hills Subdivision. Visual impacts under this alternative viewed from Valley Hills Subdivision would be the same as described for Highway 40 in

Section 3.18.6.4.1. These impacts, viewed from the background distance zone, would be noticeable as contrasts in color, line, texture and landform. Adverse visual impacts would be reduced as a well defined riparian zone emerges along the river corridor in 15 to 30 years. Over the long-term, visual quality would be improved by establishing an expanded riparian corridor that would enhance color, texture and irregular vegetation boundary.

3.15.6.4.3 Visual Impacts Viewed From Memorial Hill. Visual impacts under this alternative viewed from Memorial Hill would be the same as described for Highway 40 in Section 3.18.6.4.1. These impacts would be noticeable from the background and middle ground distance zones as contrasts in color, line, texture and landform. Long-term visual improvement from establishing an expanded riparian corridor would include enhancement of texture, color and irregular edge line.

3.15.6.4.4 Impact Summary. Vegetation disturbance from construction of the Existing Channel Modification Alternative would cause short-term changes to color, texture, landform and line when viewed from the three critical viewpoints. Long-term visual improvement would occur over time as riparian vegetation becomes established, resulting in enhancement of color and texture and an irregular vegetation boundary line.

3.15.6.5 Instream Structures Alternative

3.15.6.5.1 Visual Impacts Viewed From Highway 40. No significant visual impacts are expected from this alternative. Removal of minor amounts of bank vegetation for construction of in-stream structures would not be visually detectable from this viewpoint.

3.15.6.5.2 Visual Impacts Viewed From Valley Hills Subdivision. No significant visual impacts are expected from this alternative as described in Section 3.15.6.5.1.

3.15.6.5.3 Visual Impacts Viewed From Memorial Hill. No significant visual impacts are expected from this alternative as described in Section 3.15.6.5.1.

3.15.6.5.4 Impact Summary. No significant adverse visual impacts are expected from this alternative.

3.15.6.6 No Action Alternative

The No Action Alternative would have no visual resource impacts. The baseline visual characteristics described in Section 3.15.5 would continue under the No Action Alternative.

3.16 Recreation Resources

3.16.1 Introduction

The recreation analysis addresses potential impacts on recreation from the construction, operation and management of the Proposed Action and alternatives. The focus of the analysis is on increases and decreases in the number of angler days related to aquatic habitat and fish production. The recreation analysis methodology is presented in Appendix B, Section B.3.15. The following recreation impact topics are addressed in the impact analysis:

- Changes in the quantity of recreation use (angler days)
- Physical impacts on existing and proposed recreation areas
- Impacts on the quality of recreation at existing and proposed areas

3.16.2 Issues Eliminated From Further Analysis

The following issues were raised during scoping and eliminated from further analysis:

- How would the Utah State Parks Plan be evaluated in the Environmental Impact Statement (EIS), and what would be the cumulative impact of implementing the Utah State Parks Provo River Recreation Project with the PRRP? (This project is also referred to as the Parkway Project and would include new recreation facilities and other improvements to the Provo River corridor between Jordanelle and Deer Creek reservoirs).

This issue was eliminated from further analysis because there are no plans to implement the Parkway Project.

- What opportunities would there be to provide fence crossings that allow pedestrian access without damaging existing fences?

  This issue was eliminated from further analysis because public access is provided along the river corridor under baseline.

- What types of recreational activities would be permitted, and what restrictions would be placed on the types of fishing allowed?

  Types of future recreation activities that would be allowed beyond fishing have not been specifically determined. This issue will be decided at the time of final design.

3.16.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What would be the recreational capacity of the river under PRRP?
- What impacts would increased recreational use by fishermen, hikers, bikers, joggers and others have on highly sensitive areas along the river?

3.16.4 Description of Impact Area of Influence

The recreation impact area of influence includes approximately 10 miles of Provo River corridor between Jordanelle and Deer Creek reservoirs and adjacent recreation areas such as the Wasatch Mountain State Park, and recreation facilities at Jordanelle and Deer Creek reservoirs. Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence.

3.16.5 Affected Environment (Baseline Conditions)

Anglers fish the Provo River throughout the fishing season, gaining access through fences, controlled easement roads and private roads with and without permission from land owners. Much of the Provo River is now open for public use. Baseline conditions include seven access points to be constructed along the Provo River to provide contiguous recreation access to the river corridor, as well as parking and toilet facilities. About 1,680 angler days are supported by the baseline fish population (see Section 3.5, Aquatic Resources). An angler day equals a person fishing for 2.6 hours.

3.16.6 Impact Analysis

3.16.6.1 Significance Criteria

Significance criteria for impacts on recreation are the same as described in Section 3.16.6.1 of the WCWEP and DRP EIS.

3.16.6.2 Potential Impacts Eliminated From Further Analysis

None of the potential recreation impacts have been eliminated from further analysis.

3.16.6.3 Proposed Action (Riverine Habitat Restoration)

The following subsections describe potential recreation impacts during and after construction of the Proposed Action.

3.16.6.3.1 Changes in Recreation Use. Construction of the Proposed Action would result in a potential long-term increase of 9,444 additional angler days a year (662 percent) over baseline conditions for the nine Provo River reaches (see Map 3-1 in Section 3.1.1.1). This increase would occur over 15 to 20 years as the fish population increases with improvements in habitat and carrying capacity (see Section 3.5, Aquatic Resources, and Appendix B, Section B.3.15, Recreation Analysis Methodology).

3.16.6.3.2 Physical Impacts on Recreation Areas. The Proposed Action would cause long-term improvements in the recreational fishery, including a meandering river channel with pools and riffles, and a more scenic and natural river corridor for walking, jogging and wildlife observation. Sensitive riparian areas would be adversely impacted by heavy recreation use if vegetation is trampled or sensitive habitats are disturbed.

3.16.6.3.3 Impacts on Recreation Quality. Recreation quality would be enhanced over the long-term because of the increase in fish standing crop, which would provide greater angling opportunities. Recreation quality also would be enhanced by improved scenic quality and ecological diversity from the development of a naturally functioning river system and associated environment.

Recreation quality would be temporarily reduced during construction in specific reaches by noise, exhaust, equipment operation and lack of recreation access in the immediate construction zone.

3.16.6.3.4 Impact Summary. Table 3-34 summarizes potential increases in recreation angler days under the Proposed Action on. This increase would occur incrementally over the long-term as each reach is constructed and habitat improvements increase the fish population. Sensitive riparian areas could be adversely impacted by heavy recreation use if vegetation is trampled or sensitive wildlife and endangered species habitats are disturbed.

3.16.6.4 Existing Channel Modification Alternative

3.16.6.4.1 Changes in Recreation Use. Construction of this alternative would have the same impacts on recreation use as described for the Proposed Action in Section 3.16.6.3.1, except that the long-term potential increase in annual recreation angler days for the nine Provo River reaches would be 2,786 additional angler days (or 266 percent) over baseline conditions (see Appendix B, Section B.3.15 Recreation Analysis Methodology).

3.16.6.4.2 Physical Impacts on Recreation Areas. This alternative would cause long-term improvements in the recreational fishery, including pools and riffles. Sensitive riparian areas could be adversely impacted by heavy recreation use if vegetation is trampled or sensitive wildlife and endangered species habitats are disturbed.

3.16.6.4.3 Impacts on Recreation Quality. Recreation quality would be enhanced over the long-term because of the increase in fish population, which would provide greater angling opportunities.

Recreation quality would be temporarily reduced during construction in specific reaches by noise, exhaust, equipment operation and lack of recreation access in the immediate construction zone.

3.16.6.4.4 Impact Summary. Table 3-35 shows the potential increase in recreation angler days under the Existing Channel Modification

Table 3-34
Potential Increase In Annual Recreation Angler Days
Under the Proposed Action (Riverine Habitat Restoration)

Reach	Baseline Angler Days Per Year	Net Increase in Angler Days/Year	Percent Increase Over Baseline
1	147	0	0
2	209	965	606
3	160	1,337	1,056
4	294	1,117	541
5	152	861	1,174
6	417	1,500	808
7	204	754	528
8	113	1,007	991
9	186	1,699	1,014
Total	**1,882**	**9,240**	**662**

Alternative. The increase would occur incrementally over the long-term as each reach is constructed and habitat improvements increase fish production. Sensitive riparian areas would be adversely impacted by heavy recreation use if vegetation is trampled or sensitive wildlife and endangered species habitats are disturbed.

3.16.6.5 Instream Structures Alternative

3.16.6.5.1 Changes in Recreation Use. Construction of this alternative would have the same impacts on recreation use as described for the Proposed Action in Section 3.16.6.3.1, except that the long-term potential increase in annual recreation angler days for the nine Provo River reaches would be an additional 806 (148 percent) over baseline conditions.

3.16.6.5.2 Physical Impacts on Recreation Areas. This alternative would cause long-term improvements in the recreational fishery from installation of instream fish habitat structures. Sensitive riparian areas could be adversely impacted by heavy recreation use if vegetation is trampled or sensitive wildlife and endangered species habitats are disturbed.

3.16.6.5.3 Impacts on Recreation Quality. Recreation quality would be enhanced over the long-term because of the increase in fish population, which would provide greater angling opportunities.

Recreation quality would be temporarily reduced during construction in specific reaches by noise, exhaust, equipment operation and lack of recreation access in the immediate construction zone.

3.16.6.5.4 Impact Summary. Table 3-36 summarizes the potential increase recreation angler days under the Instream Structures Alternative This increase would occur incrementally over the long-term as habitat improvements are realized and fish standing crop increases.

Table 3-35
Potential Increase In Annual Recreation Angler Days
Under Existing Channel Modification Alternative

Reach	Baseline Angler Days Per Year	Net Increase Angler Days/Year	Percent Increase Over Baseline
1	147	0	0
2	209	346	166
3	160	602	376
4	294	394	134
5	152	189	125
6	417	251	60
7	204	157	77
8	113	241	214
9	186.0	656	353
Total	**1,882**	**2,836**	**251**

Table 3-36
Increase In Annual Recreation Angler Days
Under Instream Structures Alternative

Reach	Baseline Angler Days Per Year	Net Increase Angler Days/Year	Percent Increase Over Baseline
1	147	0	0
2	209	143	169
3	160	108	167
4	294	202	169
5	152	104	169
6	417	287	169
7	204	25	112
8	113	76	167
9	186	159	185
Total	**1,882**	**1,104**	**159**

3.16.6.6 No Action Alternative

The No Action Alternative would have no impacts on recreation resources. The baseline recreation conditions described in Section 3.16.5 would continue under the No Action Alternative.

3.17 Cultural and Paleontological Resources

3.17.1 Introduction

This analysis addresses potential impacts on cultural and paleontological resources during construction of the Proposed Action and other alternatives. The focus of the analysis is on prehistoric, historic, ethnographic and paleontological resources. The information and analysis documented in this section was summarized from the Draft Cultural Resources Technical Report (CUWCD 1996f). Assumptions and impact topic analysis methods are summarized in Appendix B, Section B.3.16. The following impact topics are addressed in this impact analysis:

- Cultural impacts during construction
- Paleontological impacts during construction

3.17.2 Issues Eliminated From Further Analysis

The following issues were raised during scoping and eliminated from further analysis:

- What impact would proposed changes in streamflow have on paleontological resources?

  There would be no adverse effects on paleontological resources because there would be no changes in streamflow under the Proposed Action and alternatives.

- What would be the impact on cultural resources from modifications to or removal of levees and dikes?

  All levees and dikes were placed in the river in the 1950s indicating that these are not historic features.

3.17.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- What would be the impact of new channel or side channel construction?

- What would be the impact of O&M road construction?
- What would be the impact of disturbance or expansion of the 100-year floodplain?
- What would be the impact of enhancement or stabilization of the river channel and banks?
- What would be the impact of modifications to possibly historic bridges

3.17.4 Description of Impact Area of Influence

The cultural and paleontological resources impact area of influence consists of all areas of construction of the Proposed Action and alternatives along the Provo River between Jordanelle Dam and Deer Creek Reservoir. Map 3-1 in Section 3.1.1.1 shows the direct impact area of influence.

3.17.5 Affected Environment (Baseline Conditions)

Existing literature studies indicate that seven historic cultural resource sites were recorded in and near the impact area of influence, and no prehistoric sites were recorded. These sites are described in Section 3.17.5.1 of the WCWEP and DRP EIS. Only a small portion of the impact area of influence has been previously surveyed, so these sites may not accurately represent additional sites which may be located in the impact area of influence.

3.17.6 Impact Analysis

3.17.6.1 Significance Criteria

The cultural and paleontological significance criteria are the same as described in Section 3.17.6.1 of the WCWEP and DRP EIS.

3.17.6.2 Potential Impacts Eliminated from Further Analysis

None of the potential cultural and paleontological impacts of the PRRP have been eliminated from further analysis.

3.17.6.3 Proposed Action (Riverine Habitat Restoration)

No known cultural resources would be adversely impacted by the Proposed Action, but it is likely that historic farmsteads, sheds, fences and other historic features that have not yet been recorded could be adversely affected. Since complete cultural and paleontological resources surveys of the impact area of influence have not been completed, the location and extent of potential impacts on these resources is not known.

3.17.6.4 Existing Channel Modification Alternative

This alternative would have the same potential impacts as described in Section 3.17.6.3.

3.17.6.5 Instream Structures Alternative

This alternative may have minor impact on cultural resources because some ground disturbance would take place outside the channel when placing instream structures in the existing Provo River channel. However, the extent of these potential impacts is not known because surveys of these areas have not been completed.

3.17.6.6 No Action Alternative

The No Action Alternative would have no impacts on cultural resources. Baseline conditions would continue as described in Section 3.17.5 under the No Action Alternative.

3.18 Transportation

3.18.1 Introduction

The transportation analysis addresses potential impacts on transportation systems during and after construction of the Proposed Action and alternatives. The focus of the analysis is on potential traffic impacts during construction. The methodology used to conduct the transportation analysis is described in Appendix B, Section B.3.17. The following transportation impact topics are addressed in the impact analysis:

- Transportation impacts during construction (changes in traffic and physical impacts on roads)
- Transportation impacts after construction (changes in traffic)

3.18.2 Issues Eliminated From Further Analysis

None of the transportation issues raised during scoping have been eliminated from further analysis.

3.18.3 Issues Addressed in the Impact Analysis

The following issues were raised during scoping and are addressed in the impact analysis:

- How would existing bridges be affected by the PRRP?
- What effects would the PRRP have on roads and transportation systems during construction?
- What effects would increased recreational use of the Provo River have on transportation systems?

3.18.4 Description of Impact Area of Influence

The transportation impact area of influence consists of roads that would be used during construction of the Proposed Action and alternatives, bridges affected by construction, and roads that would be used by recreationists to access the Provo River following construction. The specific roads included in the impact area of influence are defined in Section 3.18.5.

3.18.5 Affected Environment (Baseline Conditions)

The Heber Valley road system consists of three major roads: two federal highways (Highways 40 and 189) and a state highway (Highway 113). These three roads and River Road would be the primary travel routes for construction workers, other construction vehicles and recreationists. Other local roads would be less affected.

Baseline AADT traffic levels, which would exist during construction around the year 2000, are expected to be 10,550 on Highway 40; 3,748 on Highway 113; 1,262 on River Road; and 6,167 on Highway 189. Peak traffic occurs during commute hours when many Heber Valley residents commute to Provo, Orem, Park City or Salt Lake City. While traffic data is not available for other roads that would be affected by the PRRP, construction traffic on these roads would be more dispersed and lighter than on the roads identified above.

Two bridges would be affected by the PRRP: the private Casper Bridge in Reach 2 and another private bridge in the upper portion of Reach 9 (see Map 3-1 in Section 3.1.1.1). These bridges are only used by adjacent property owners to cross the Provo River

3.18.6 Impact Analysis

3.18.6.1 Significance Criteria

The significance criteria for the PRRP Proposed Action and alternatives are the same as described in Section 3.18.6.1 of the WCWEP and DRP EIS.

3.18.6.2 Potential Impacts Eliminated From Further Analysis

Physical impacts on roads from heavy construction vehicles were eliminated from further analysis because the SOPs defined in Section 1.11.7 of Chapter 1 include a commitment to repair all damage to local roads from PRRP construction activities.

3.18.6.3 Proposed Action (Riverine Habitat Restoration)

3.18.6.3.1 Transportation Impacts During Construction. Construction of the Proposed Action would cause the following types of transportation impacts:

- An increase in the amount of traffic on local roads as workers commute to and from construction sites, and various types of other vehicles are used during construction

- An increase in the amount of traffic on local roads as soil, rocks and other spoil material (also referred to as waste material) is hauled to the disposal site near Highway 189 and Charleston

- Physical impacts on roads from the traffic described above and on two bridges from construction procedures

The Proposed Action would be constructed in reaches, starting near Jordanelle Reservoir. This would congregate traffic on roads near the segments that are being constructed. When construction occurs north of Heber City and near Highway 40 (Reaches 9, 8 and 7), construction traffic would congregate on Highway 40. During this phase, trucks used to remove spoil from the construction area would travel south on Highway 40 and southwest on Highway 189 to the spoil disposal site near Charleston. As construction moves to Reaches 6 and 5, traffic would congregate on River Road. Construction traffic would be concentrated on Highway 113 when construction moves further downstream in Reaches 4, 3, 2 and 1. The spoil disposal trucks would travel south on Highway 113 or Highway 40 to Highway 189.

Traffic would increase on Highways 40, 113 and 189 and River Road during the entire construction period as workers commute to work sites from the Salt Lake City, Provo and Orem areas. Traffic would increase on smaller, local roads that would be used by construction workers living in Heber Valley. Heavy construction vehicles such as bulldozers, excavators and backhoes would be left overnight at construction sites and moved short distances from one construction segment to another. The average duration of construction per Reach would be about 1 year.

Table 3-37 summarizes the peak traffic impacts of the Proposed Action and alternatives. Peak traffic during construction would occur where construction workers and spoil disposal trucks would need to travel on the same road. This is expected to occur on Highway 40 north of the junction with Highway 113, on River Road, and on Highway 113. The incremental increase in peak traffic on River Road and Highways 40, 189 and 113 is provided along with the percentage increase in peak traffic.

A daily peak of about 39 construction-related round-trips would occur under the Proposed Action on Highways 40 and 113 and River Road, including 29 worker round-trips (4 of them management staff round-trips), and 10 round-trips by spoil disposal trucks. This would be a peak daily increase of 78 total trips on each road. A total of 27,300 construction-related round-trips would occur in the impact area of influence over the entire construction period of 5 years and 7 months.

In addition to the peak traffic impacts, less concentrated and smaller increases in traffic would occur on the roads noted above and others in Heber Valley during the entire construction period. Local roads would experience minor traffic increases from an estimated seven workers that would likely commute from Heber Valley to construction sites.

Traffic increases during construction of the Proposed Action would not have adverse and significant impacts because they would not cause delays except for possible minor delays for motorists who might have to wait to pass large trucks. The Proposed Action would not cause delays because the capacities of the affected roads are more than sufficient to handle the estimated increases in traffic associated with construction (see related discussion in Section 3.18.6.3.1 of the WCWEP and DRP EIS).

Construction of the Proposed Action would require reconstruction of two private bridges, the Casper Bridge in Reach 2 and another in Reach 9. The bridges, used only by adjacent property owners, would be unusable for about 2 months, causing some temporary delays and inconvenience for people who would need to use alternate transportation routes.

3.18.6.3.2 Transportation Impacts After Construction. The Proposed Action would be self-sustaining and would require very little maintenance. Infrequent inspections and maintenance by a limited number of workers would cause a minor increase in traffic on local roads.

Additional recreationists would be attracted to the Provo River after the Proposed Action is constructed (see Recreation analysis in Section 3.16). This would increase traffic primarily on Highways 40, 113 and 189, and River Road as recreationists drive to the Provo River. The increase in traffic would not be significant because it would not cause delays to motorists on the affected roads.

Table 3-37
Peak Traffic Impacts During Construction of the Proposed Action and Alternatives (Daily Vehicle Trips)

	Highway 189 (From Charleston to Hwy. 40 Junction)	Highway 40 (From Jordanelle Dam to Hwy. 189 Junction)	River Road (From Hwy. 40 Junction to Hwy. 113 Junction)	Highway 113 (From Hwy. 40 Junction to Hwy. 189 Junction)
PROPOSED ACTION (RIVERINE HABITAT RESTORATION)				
Baseline Traffic[1]	6,167	10,550	1,262	3,748
Total Peak Traffic During Construction[2]	6,206	10,628	1,340	3,826
Increase in Traffic	39	78	78	78
Percent Change	**1.0%**	**1.0%**	**6.2%**	**2.1%**
EXISTING CHANNEL MODIFICATION ALTERNATIVE				
Baseline Traffic	6,167	10,550	1,262	3,748
Total Peak Traffic During Construction	6,188	10,589	1,340	3,787
Increase in Traffic	42	78	78	78
Percent Change	**1.0%**	**1.0%**	**6.2%**	**2.1%**
INSTREAM STRUCTURES ALTERNATIVE				
Baseline Traffic	6,167	10,550	1,262	3,748
Total Peak Traffic During Construction	6,172	10,563	1,288	3,761
Increase in Traffic	12	26	26	26
Percent Change	**0.2%**	**0.2%**	**2.1%**	**1.0%**

Notes:

[1] Baseline traffic data are estimates of Annual Average Daily Trips in the year 2000; Source: UDOT 1992 data adjusted with a 3 percent annual growth rate

[2] Total peak traffic during construction is baseline traffic plus peak daily vehicle trips during construction of the Proposed Action and alternatives

3.18.6.3.3 Impact Summary. The Proposed Action would increase traffic during construction and as recreationists drive to the Provo River corridor after construction. The largest increase in traffic during construction would occur on River Road (a peak increase of 6.2 percent). Two private bridges also would be reconstructed.

3.18.6.4 Existing Channel Modification Alternative

3.18.6.4.1 Transportation Impacts During Construction. Transportation impacts for this alternative would be the same as for the Proposed Action in Section 3.18.6.3.1, except this alternative would not impact bridges.

Table 3-37 includes a summary of the peak traffic impacts of this alternative. A peak of about 39 construction-related, daily round-trips would occur on Highway 40, River Road and Highway 113. About 21 construction-related, daily round-trips would occur on Highway 189. A total of 20,700 construction-related round-trips would occur in the impact area of influence over the entire construction period of 4 years and 1 month. Since these traffic increases would be well within the capacity of the roadways, they not cause significant delays to motorists.

3.18.6.4.2 Transportation Impacts After Construction. This alternative would require very little maintenance. Infrequent inspections and maintenance by a limited number of workers would cause an insignificant increase in traffic on local roads.

The increase in recreation opportunity caused by this alternative would cause an increase in traffic on Highways 40, 113 and 189, and River Road as recreationists travel to the Provo River. The increase in traffic would not be significant because it would not cause delays to motorists on the affected roads.

3.18.6.4.3 Impact Summary. This alternative would cause increases in traffic during construction and as recreationists drive to the Provo River corridor. The largest increase in traffic during construction would occur on River Road (a peak increase of 6.2 percent).

3.18.6.5 Instream Structures Alternative

3.18.6.5.1 Transportation Impacts During Construction. Construction of this alternative would increase traffic as workers drive to sites and haul rocks. Spoil disposal trips would not be necessary, and this alternative would not impact traffic on bridges. The same roads used by workers to construct the Proposed Action would be used to construct this alternative.

About six construction-related, daily round-trips would occur on Highway 189. The maximum percentage increase in AADT during construction of this alternative would be less than 1 percent on Highways 40 and 189, about 1 percent on Highway 113, and about 2 percent on River Road. A total of 926 construction-related round-trips would occur in the impact area of influence over the entire construction period of 5 months. Since these traffic increases would be well within the capacity of the roadways, they would not cause significant delays to motorists.

3.18.6.5.2 Transportation Impacts After Construction. This alternative would require very little maintenance. Infrequent inspections and maintenance by a limited number of workers would not cause a significant increase in traffic on local roads.

The increase in recreation opportunities caused by this alternative would primarily increase traffic on Highways 40, 113 and 189 and River Road as recreationists travel to the Provo River. The increase in traffic would not be significant because it would not cause delays to motorists on the affected roads.

3.18.6.5.3 Impact Summary. This alternative would cause increases in traffic during construction and as recreationists drive to the Provo River corridor. The largest increase during construction would occur on River Road (a peak increase of 2.1 percent).

3.18.6.6 No Action Alternative

The No Action Alternative would have no impacts on transportation. Baseline conditions described in Section 3.18.3.4 would continue under the No Action Alternative.

3.19 Mitigation

3.19.1 Introduction

This section describes proposed mitigation for significant impacts caused by the Proposed Action and PRRP alternatives. Mitigation measures are proposed where feasible and practical for resources that would incur significant impacts.

3.19.2 Wetlands

The overall intent of the Proposed Action is to restore a naturally functioning riverine system that would provide for restoration, enhancement and creation of high-value, functioning wetland habitats within the river corridor. However, construction of the Proposed Action and the Existing Channel Modification Alternative would result in the temporary and permanent loss of some existing wetlands.

3.19.2.1 Wetland Mitigation Priorities

The Mitigation Commission would mitigate for wetland impacts of the Proposed Action by developing specific wetland mitigation plans for each segment of the river during final design and before applying for a Section 404 Permit from the

COE. Following is the Mitigation Commission's prioritized wetland mitigation approach:

1) Steps will be taken during final design to reduce the wetland impacts on all wetland types to the extent possible. Analyses presented in this EIS represent maximum anticipated adverse impacts.

2) The Mitigation Commission will seek opportunities to restore and enhance existing wetlands or to create wetlands within the reconstructed floodplain (under the Proposed Action and Existing Channel Modification Alternative) so they would function and be maintained naturally through connection with the riverine hydrology as a project feature.

3) Enhancement or restoration of existing wetlands through protection and management for wetland value, instead of agricultural or other objectives, would be pursued on properties acquired adjacent to the 2-year floodplain.

4) The Mitigation Commission would propose similar wetland restoration projects outside the immediate project vicinity that would provide high-value wetlands protection and management capabilities.

5) The Mitigation Commission would construct features (i.e., diversions, dikes) in the project vicinity to create new wetlands in suitable locations, only after opportunities to provide wetlands within the floodplain area have been maximized.

3.19.2.2 Summary Description of Impacted Wetlands

Under the Proposed Action, 55.2 acres of emergent marsh and wet/moist meadow wetlands would be removed by construction of the new river channel, floodplain grading and placement of setback dikes. An estimated 20.6 acres of wet/moist meadow and emergent marsh would be created or enhanced by development and management of ponds and side channels, leaving a net adverse impact on wet/moist meadow wetland of 34.6 acres. The 34.6 acres includes 26.1 acres of mitigation wetlands constructed by USBR as partial mitigation for wetland impacts of Jordanelle Dam, a component of the Municipal and Industrial System of the Bonneville Unit. This wetlands mitigation was previously required by the COE under a Section 404 Permit that required USBR to accomplish successful wetland mitigation by 1998. Mitigation measures proposed by the Mitigation Commission for this anticipated impact are described in greater detail in the following sections

The impacted wet/moist meadow wetlands have functional values ranging from very low to relatively high. Low-value wetlands that would be removed by construction of the Proposed Action and the Existing Channel Modification Alternative consist of irrigated agricultural fields used mainly for hay production and pasture. These wetlands have the following characteristics: 1) they are relatively flat and interspersed throughout upland areas; 2) wetland species are dominated by Nebraska sedge, Kentucky bluegrass and reed canary grass; 3) the water source consists of flood irrigation or irrigation drainage and return flow that collects on the surface — in some cases because it is blocked by dikes from reaching the river; and 4) many of the low-functioning agricultural wetlands are grazed by livestock. Because many of these low-value wet/moist meadow wetlands do not meet federal criteria for jurisdictional wetlands, they are not regulated or protected under Section 404. They are subject to land use changes, deliberate drainage and changes in water management practices that could affect their existence in the future.

Higher-value wetlands are composed of a mosaic of wetland community types that include diverse topography, a wide range of water regimes, organic soils, and a diversity of plant communities. The majority of the high-value wetlands are on publicly owned lands in Reaches 7, 8 and 9.

3.19.2.3 Proposed Wetland Mitigation

One potential mitigation measure for the Proposed Action or Existing Channel Modification Alternative is the permanent protection and enhancement of a property that was recently purchased for angler access and PRRP purposes. The property is situated in Reaches 7 and 8, and includes a total of 64.7 acres consisting of 40.6 acres on the west side of the Provo River, 17.2 acres between the east side of the river and U.S. Highway 40, and 6 acres in the existing Provo River channel. (See Map A-10 in pocket at back of EIS). The property receives water from several readily identifiable sources including: 1) groundwater from Condie Pond; 2) hillside seeps and springs on the western boundary; 3) surface stream flows, and 4) an apparent perched water table in some areas. Wetland community types found on the property include sedge meadows, riparian woodland and emergent marsh. Flowing channels and interspersed upland islands add additional biodiversity. The wetland communities on the property provide important wildlife habitat for a number of wetland-dependent mammals, waterfowl and song birds. There also is habitat for Ute ladies'-tresses which is a Threatened species, and spotted frog, a Category 1 candidate species as identified by FWS (see Section 3.19.3). Certain wetland functions, such as wildlife habitat, are reduced from their potential because the property was grazed and not managed for wetland values before it was acquired. A small portion of the property also is overgrown with several thistle species.

The property is bounded on the south by another parcel recently acquired by the Nature Conservancy that also contains high-value wetlands. In combination, these lands provide some of the best wetland habitat within the impact area of influence. The location of the property in relationship to these Nature Conservancy wetlands makes it more valuable as a mitigation area that can be enhanced and protected. The completed acquisition of the proposed mitigation property and elimination of livestock grazing enhances and protects the higher wetland functions and values up-front, before any impacts occur from construction of the PRRP.

Five additional properties along the Provo River have been reviewed by the Mitigation Commission for opportunities to protect and enhance wetland values as mitigation areas. Not all of the five properties would be required. Following are brief descriptions of these properties.

- Property 1. This 24-acre parcel is on the east side of the Provo River at the upper end of Reach 4, in the NW 1/4 of the SW 1/4 of Section 25, Township 3 South, Range 4 East. The parcel is a wet meadow type wetland with a ditch running along the western boundary and through a cat-tail slough on the northwest side. The parcel receives water from over-irrigation of adjacent lands. Vegetation includes sparse willows adjacent to the river, sedges, wiregrass and pasture grass. This property is potential habitat for peregrine falcon, Ute Ladies-tresses and spotted frog. Enhancement and protection against future development of the property also provides a buffer along the river that would help protect water quality.

- Property 2. This 21-acre parcel is on the west side of the Provo River in Reach 3, just south of the Heber City wastewater treatment plant lagoons in the NE 1/4 of the SW 1/4 of Section 1, Township 4 South, Range 4 East. The present land use is irrigated pasture. The general lay of the land is flat with undulating micro-topography that collects surface water. Wet meadow vegetation is composed of sedges, wiregrass and pasture grasses with scattered clumps of cottonwood, hawthorn and willows. Existing water supplies include irrigation drainage, the Everett Slough and groundwater discharge from upgradient areas. Downed trees and other woody debris provide cover and micro-habitats for wildlife species. The property is potential habitat for Ute Ladies-tresses and spotted frog. Enhancement and protection of this property also provides a buffer between the wastewater lagoons and the river that could help protect water quality.

- Property 3. This 34-acre parcel is on the west side of the Provo River in the NW 1/4 of the SW 1/4 of Section 1, Township 4 South, Range 4 East. It is contiguous to Property 2 described above. The present land use is irrigated pasture. Topography, water supply and vegetation are very similar to Property 2.

- Property 4. This 29-acre parcel is in the NE 1/4 of the NE 1/4 of Section 11, Township 4 South, Range 4 East. It is comprised of following three properties: 1) 8 acres on the west side of the Provo River immediately south of the railroad bridge; 2) 12 acres on the east side of the river immediately south of the railroad bridge and 3) 9 acres on the west side of the Provo River just north of the railroad bridge. The present land use is irrigated pasture. The water supply to the 8 and 9 acre properties is fed by Island Ditch irrigation return flows, Everett Slough return flows and groundwater discharge. Water supply to the 12-acre parcel is from the lower Charleston Canal and groundwater discharge. Existing ditch channels meander through the overall parcel. There is a small open-water area on the northwest parcel where the Everett Slough discharges into the Provo River. The soils are Kovich series. Vegetation includes sedge, wiregrass and pasture grasses. This parcel offers opportunities for protection and enhancement of high-value wetland functions (i.e., water quality, wildlife and threatened and endangered species habitat).

- Property 5. This is a 25- to 30-acre parcel situated in the SE 1/4 of the NW 1/4 of Section 1, Township 4 South, Range 4 East, between the lower Charleston Canal and Spring Creek, about 500 to 600 feet from the east bank of the Provo River. The gently sloping site has undulating micro-topography with meandering irrigation drainage channels, dense soils and a perched water table. The present land use is irrigated pasture. The parcel offers opportunities for enhancement of wetland soils and vegetation through elimination of grazing and protection of habitat for wildlife and threatened and endangered species. Protection against future development would provide a buffer for this segment of Spring Creek.

Following are overall ecological benefits of enhancing and protecting existing wetlands on properties adjacent to the Provo River and contiguous with the PRRP corridor as mitigation for impacts under the Proposed Action:

- On-site, in-kind mitigation for wet/moist meadow wetland losses
- Improvement of plant and animal biodiversity
- Establishment of an expanded, protected wetland and riparian buffer along certain reaches of the Provo River. This would help protect water quality and upgrade wildlife habitat carrying capacity, including habitat for Ute ladies'-tresses and spotted frog
- Control of noxious weeds
- Permanent protection of some non-jurisdictional wetlands that could otherwise be lost due to future land-use changes, modifications to water management practices or intentional drainage as the Heber Valley continues to develop in the future. As unprotected wetlands are developed, protected wetlands will become more socially significant.
- Elimination of impacts from livestock grazing
- The building and maintenance of productive organic wetland soils through production and decay of wetland plant materials

3.19.2.4 Wetland Mitigation Monitoring

Enhancement and protection of all the mitigation properties would be monitored by the Mitigation Commission or their authorized representative to determine and document that wetland enhancement and protection of wetland values are meeting mitigation goals and objectives that would be identified by the COE in a Section 404 Permit. Monitoring would be conducted twice yearly during the growing season to evaluate soil moisture, side-channel flows, plant succession, regeneration and production, weed invasion, species diversity and the presence of threatened and endangered species. A monitoring report would be prepared to document monitoring results and define any future actions needed to make sure the mitigation properties reach their full wetland-value potential.

3.19.3 Threatened and Endangered Species

3.19.3.1 Ute Ladies'-tresses

Riparian woodlands developed in the constructed floodplain under the Proposed Action and Existing Channel Modification Alternative would fully replace habitat for Ute ladies'-tresses that would be removed during construction. If habitat needs would not be met by development of riparian woodlands, additional measures would be identified and implemented.

Existing colonies of Ute ladies'-tresses would be conserved by allowing water to flow continuously into the occupied side-channels from the new river location. A proposed side channel under the Proposed Action in a portion of the current Provo River channel near the known colonies would receive continuous flow from the new river channel and some overflow during flooding events. Continuous flow into this side channel would minimize the potential for loss of the colonies, and a 170-foot buffer zone around the colonies would be sufficient to avoid impacts of construction. This buffer zone would be surrounded by orange fencing and posted with signs stating "Conservation Area —

Do Not Disturb." The presence of threatened Ute ladies'-tresses would not be stated on the signs to avoid unwanted attention.

The constructed floodplain and resulting riparian woodland proposed in Reaches 7 and 8 would provide additional suitable habitat for Ute ladies'-tresses. Flood flows would occur over the floodplain every other year, and scouring flows would occur every 3 to 5 years, exposing gravels and depositing sediments that would provide additional Ute ladies'-tresses habitat — a combination that would improve the potential for Ute ladies'-tresses to disperse in this additional habitat. The periodic flooding would supply water to known colonies, thereby enhancing the probability for continued existence of the Ute ladies'-tresses colony. Wetland enhancement at the proposed wetland mitigation site (see Section 3.19.2) would improve the potential for dispersal of Ute ladies'-tresses by providing additional and more suitable habitat.

An annual monitoring program would be designed to document site conditions, development of new habitat, and the status of the Ute ladies'-tresses colonies during the optimum blooming period, which varies year-to-year. These efforts would be coordinated with the proposed wetland mitigation monitoring described in Section 3.19.2.

3.19.3.2 Spotted Frog

Conservation measures for spotted frog would be the same as described in Section 3.19.5 of the WCWEP and DRP EIS.

3.19.4 Cultural Resources

Before construction, a complete inventory of prehistoric and historic resources would be completed at all sites in the impact area of influence where disturbances would occur to identify potentially significant impacts on cultural resources. The inventory would be conducted under a Programmatic Agreement (PA) that is being formalized between the DOI, the Mitigation Commission, Utah State Historic Preservation officer, and the Advisory Council on Historic Preservation. The PA would ensure that all potentially significant impacts on cultural resources are identified, eligibility is determined for National Register of Historic Places and appropriate mitigation is implemented. Potential impacts on sites eligible for the National Register of Historic Places would be mitigated through HABS/HAER documentation, excavation or other measures deemed appropriate.

Paleontological inventory would be conducted in the impact area of influence where the fossil record potentially exists. Fossils would be collected or sampled if located, and monitoring of excavation work by a paleontologist would be required in critically sensitive localities.

3.20 Unavoidable Adverse Impacts

3.20.1 Introduction

This section describes unavoidable adverse impacts that would occur under the Proposed Action (Riverine Habitat Restoration) and alternatives. These impacts, presented by resource in the sections below, are adverse impacts that remain after mitigation.

There would be no unavoidable adverse impacts under the Proposed Action and alternatives for the following resources since they either did not have any adverse impacts or no adverse impacts remained after mitigation.

- Water resources
- Wetlands
- Aquatic resources
- Wildlife resources

3.20.2 Water Quality

TSS and TP concentrations in the Provo River, and subsequent loads to Deer Creek Reservoir, would increase slightly during and immediately after construction and decrease slightly after construction and fencing of acquired lands. Temperatures in the river would increase after construction, then decrease to baseline levels, or lower, as riparian vegetation becomes re-established and provides more shade over the water's surface.

3.20.3 Threatened and Endangered Species

Unavoidable adverse impacts of the Proposed Action and alternatives would be the same as in Section 3.20.5 of the WCWEP and DRP EIS.

3.20.4 Soil Resources

Streambeds and streambanks would experience minor erosion during and immediately after construction.

3.20.5 Mineral and Energy Resources

Spoil material created during construction would be deposited at an existing excavation site, and fuel would be used by construction vehicles during construction and by recreationists' vehicles after construction.

3.20.6 Air Quality

Nitrogen oxides, sulfur oxides and particulate matter from vehicle emissions would increase during and after construction as recreationists drive to the Provo River. Dust emissions would increase during construction.

3.20.7 Agriculture Resources

Individual farming operations would have to alter agricultural practices because of the permanent loss of grazing land and cropland, and related restrictions on crossing the Provo River with vehicles and equipment, modifications to irrigation systems, and changes in cultivation and local access.

3.20.8 Socioeconomics

Farm revenue and income would decrease because of the temporary and permanent disturbance of grazing and crop land under the Proposed Action and Existing Channel Modification Alternative. Some farmers, local residents and property owners would be adversely impacted during and after construction along the Provo River because private property would be acquired under the PRRP.

3.20.9 Health and Safety

There would be a minor increase in the risk of traffic accidents for motorists driving near construction traffic and then after construction as more recreationists drive to access points along the Provo River. Flooding frequency also would increase along the Provo River, but flood flows would be contained within dikes. The increased number of recreationists and children visiting the river also would cause a minor increase in the risk of drowning.

3.20.10 Noise

Unavoidable adverse impacts would be the same as in Section 3.20.12 of the WCWEP and DRP EIS, except additional noise impacts from recreationists' vehicles would occur on roads along the Provo River.

3.20.11 Visual Resources

Vegetation and soil disturbance during construction would persist during the time required for regrowth of revegetated areas to a size comparable to the vegetation removed (about 2 to 7 years depending on vegetation type). Removal of cottonwood trees also would impact visual resources during the time required for re-growth of new trees to a size comparable to the ones removed (about 15 to 30 years).

3.20.12 Recreation

Restricted access to specific areas of the river and increased noise levels would reduce the quality of the recreation experience during construction.

3.20.13 Cultural Resources

Thorough surveys of cultural and paleontological resources in the impact area of influence have not been completed, so the location and extent of potential unavoidable adverse impacts on these resources is not known.

3.20.14 Transportation

Traffic would increase during construction and as recreationists drive to the Provo River corridor after construction. Two private bridges also would have to be reconstructed under the Proposed Action, which would result in minor delays or re-routing of traffic.

3.21 Cumulative Impacts

3.21.1 Introduction

This section describes cumulative impacts of the Existing Channel Modification Alternative, Instream Structures Alternative and interrelated projects. The cumulative impacts of the PRRP Proposed Action (Riverine Habitat Restoration) and interrelated projects are not described in this section because they would be the same as those described in Section 3.21.2 of the WCWEP and DRP EIS.

The interrelated projects assessed in this section are the same as those described in Section 1.7 of the WCWEP and DRP EIS. The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) is considered an interrelated project for the purpose of evaluating cumulative impacts in this section.

3.21.2 Cumulative Impacts Caused by the Existing Channel Modification Alternative and Interrelated Projects

This section describes cumulative impacts caused by the Existing Channel Modification Alternative and interrelated projects that would be different than those described for the PRRP Proposed Action (Riverine Habitat Restoration) and interrelated projects in Section 3.21.2 of the WCWEP and DRP EIS.

3.21.2.1 Water Resources

Cumulative impacts on water resources under this alternative and interrelated projects would generally be the same as described for the PRRP Proposed Action (Riverine Habitat Restoration) in Section 3.21.2.1 of the WCWEP and DRP EIS.

3.21.2.2 Water Quality

Cumulative water quality impacts would include slight increases in TSS and TP concentrations in affected streams during and immediately after construction of the Existing Channel Modification Alternative and interrelated projects. However, TSS and TP concentrations would decrease to levels equivalent to or less than baseline conditions after construction site stabilization. The net result after construction would be an improvement in TSS and TP concentrations in the impact area of influence.

Minor increases in late-summer water temperatures in the Provo River and upper Rock Ditch would occur during the summer of dry years under this alternative and interrelated projects. The impact of increased water temperature would persist for about 15 to 30 years, which is the time required for cottonwoods to be re-established along streambanks at a size and height that would shade the water surface in a manner similar to baseline conditions.

This alternative and interrelated projects would cause minor, temporary increases of TSS loads in the Provo River, and sediment inflow to Deer Creek Reservoir during and immediately after construction activities. TSS loads to Deer Creek Reservoir would decrease after site stabilization. There would be a decrease in baseline TP loads, and either no change or a decrease in Deer Creek Reservoir TP concentrations under this alternative and interrelated projects. Conditions that influence thermal stratification in Deer Creek Reservoir would not be impacted by this alternative and interrelated projects.

3.21.2.3 Wetlands

The net gain of wetlands caused by the Existing Channel Modification Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would be approximately 132.4 acres. Wetlands would increase along the Provo River in Heber Valley and restored streams in the upper Strawberry River basin.

3.21.2.4 Aquatic Resources

The streamflow and habitat improvements of the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Existing Channel Modification Alternative would cause a cumulative increase of approximately 25,427 pounds of trout per year in the Provo River in Heber Valley and upper Strawberry River basin. This estimate is the cumulative increase in natural trout production.

3.21.2.5 Wildlife Resources

The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Existing

Channel Modification Alternative would cause a net increase of approximately 132.4 acres of wildlife habitat in the upper Strawberry River basin and along the Provo River in Heber Valley. Approximately 1,080 cottonwood trees along the Provo River would be removed during construction of the Existing Channel Modification Alternative. The time required for revegetation and re-establishment of newly developed areas to provide full wildlife habitat value would be the same as described for the PRRP Proposed Action (Riverine Habitat Restoration) in Section 3.21.2.5 of the WCWEP and DRP EIS.

3.21.2.6 Threatened and Endangered Species

3.21.2.6.1 Peregrine Falcon. The Existing Channel Modification Alternative, WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Highway 40 upgrade would cause adverse and beneficial cumulative impacts on peregrine falcon foraging habitat. About 121.6 acres of foraging habitat would be temporarily disturbed. About 25.9 acres of foraging habitat would be permanently removed by these projects. About 40.2 acres of foraging habitat would be restored, and 70.7 acres of foraging habitat would be protected and enhanced.

3.21.2.6.2 Bald Eagle. The Existing Channel Modification Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would permanently remove 39.7 acres of roosting habitat for bald eagles. About 141.9 acres of roosting and perching habitat would be developed along the Provo River corridor.

3.21.2.6.3 Ute Ladies'-tresses. The Existing Channel Modification Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would temporarily disturb 116.8 acres of potential habitat, and permanently remove 83.8 acres of potential habitat. About 141.9 acres of potential habitat would be developed along the Provo River corridor and an additional 70.7 acres of potential habitat would be protected and enhanced as part of interrelated projects in Heber Valley.

3.21.2.6.4 Spotted Frog. The Existing Channel Modification Alternative and interrelated projects would have adverse and beneficial impacts on spotted frogs and their habitat. About 100.9 acres of habitat would be temporarily disturbed, and 25.9 acres of habitat would be permanently removed. The Existing Channel Modification Alternative and interrelated projects would protect and enhance about 70.7 acres of spotted frog habitat in Heber Valley.

3.21.2.7 Soil Resources

The types of cumulative impacts on soil resources caused by this alternative and interrelated projects would generally be the same as described for the PRRP Proposed Action (Riverine Habitat Restoration) in Section 3.21.2.7 of the WCWEP and DRP EIS. However, some of the impacts would occur in different locations.

3.21.2.8 Mineral and Energy Resources

A total of about 257,900 gallons of fuel would be used during construction of the Existing Channel Modification Alternative and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline). About 189,900 gallons of fuel would be used during the two-year overlap in construction of this alternative and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline).

3.21.2.9 Air Quality

The maximum vehicle emissions during any 12-month period of the two-year overlap in construction of the Existing Channel Modification Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would be 228 tons of nitrogen oxides, 20 tons of sulfur oxides, and 17 tons of particulates. There would be fewer cumulative air quality impacts after construction under this alternative since it would attract less recreation-related traffic than the PRRP Proposed Action (Riverine Habitat Restoration).

3.21.2.10 Agriculture Resources

Cumulative impacts on agriculture during construction of the Existing Channel Modification Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would include temporary disruption of production during construction on approximately 220.7 acres of grazing and cropland. There would be a cumulative and permanent loss of about 0.2 acres of grazing land and 18.4 acres of cropland. This would cause the following cumulative production decreases during construction: about 350 AUMs on grazing land and pasture, 1,960 bushels of barley and 547 tons of alfalfa. During the two-year overlap in construction of the Existing Channel Modification Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline), the cumulative change in production would be a net decrease of 254 AUMs, 547 tons of alfalfa and 1,960 bushels of barley.

After construction, the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Existing Channel Modification Alternative would combine to cause an annual net increase of 1,952 AUMs and 2,011 tons of alfalfa, and a decrease of 120 bushels of barley. There also would be an infrequent and minor production loss in the floodplain of the Provo River during 100-year flood events.

3.21.2.11 Socioeconomics

Future cumulative employment, revenue and income impacts would occur during the simultaneous construction of the WCWEP and DRP Proposed Action (WCWEP and Daniel Replacement Pipeline), Existing Channel Modification Alternative and Highway 40 upgrade. The cumulative and peak increase in construction-related employment caused by these 3 projects would be approximately 164 jobs. The WCWEP and DRP Proposed Action (WCWEP and Daniel Replacement Pipeline) and Existing Channel Modification Alternative would cause a reduction in gross farm revenues during construction as land is removed from production. The cumulative loss of gross farm revenue would be about $44,000. Gross revenue in the construction and retail trade sectors would increase. The cumulative and peak annual increase in total Wasatch County revenue during construction would be approximately $726,000.

After construction, there would be a cumulative net increase of about $131,000 in total annual gross revenue in the farm sector of Wasatch County's economy. The retail trade sector of Wasatch County would experience an annual increase in gross revenue of about $120,000; therefore, the total increase in the county's gross revenue would thus be approximately $342,000 per year. This would lead to an increase in income, sales tax revenue and income tax revenue. Property tax revenues would drop about $58,000 per year as payments in lieu of taxes from the federal government begin on land that is currently private property.

3.21.2.12 Health and Safety

The cumulative increase in traffic-related hazards under the Existing Channel Modification Alternative would be slightly less than the same type of hazards associated with the PRRP Proposed Action (Riverine Habitat Restoration) since this alternative would cause smaller traffic increases during or after construction.

3.21.2.13 Recreation Resources

The Existing Channel Modification Alternative and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would cause a net increase in recreational fishing of 206,696 angler days per year. An additional 10,000 angler days per year would be made possible by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) in the upper Strawberry River basin. This would help mitigate losses attributed to the Strawberry Aqueduct and Collection System.

3.21.2.14 Transportation

This alternative and interrelated projects would cause the same type of cumulative impacts on transportation resources as the PRRP Proposed Action (Riverine Habitat Restoration) and described in Section 3.21.2.17 of the WCWEP and DRP EIS. The magnitude of the future cumulative impacts during construction would be the same as the PRRP Proposed Action (Riverine Habitat Restoration) on Highway 40 in Heber Valley and Highway 189 in the Provo River canyon. The future cumulative impacts on Highway 189 in Heber Valley would be slightly higher (approximately 3 more trips per day during the peak of construction). Cumulative traffic impacts after construction would be less than those associated with the PRRP Proposed Action (Riverine Habitat Restoration) since this alternative would attract fewer recreationists to the Provo River in Heber Valley.

3.21.3 Cumulative Impacts Caused by the Instream Structures Alternative and Interrelated Projects

This section describes cumulative impacts caused by the Instream Structures Alternative and interrelated projects that would be different than those described in Section 3.21.2 for the Existing Channel Modification Alternative.

3.21.3.1 Water Quality

The cumulative water quality impacts of this alternative and interrelated projects would be generally the same as the Existing Channel Modification Alternative described in Section 3.21.2.2. However, there would not be a change in Provo River water temperatures.

3.21.3.2 Wetlands

Future cumulative impacts on wetlands from this alternative and interrelated projects would be a net gain of approximately 53.6 acres. Since the Instream Structures Alternative would not impact wetlands, cumulative wetland impacts would be the same as those caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) alone.

3.21.3.3 Aquatic Resources

The streamflow and habitat improvements caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Instream Structures Alternative would cause an increase in natural trout production of 20,597 pounds of trout per year. These positive impacts would occur in the Provo River in Heber Valley and upper Strawberry River basin.

3.21.3.4 Wildlife Resources

The WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) and Instream Structures Alternative would cause a net increase of approximately 53.6 acres of wildlife habitat in the upper Strawberry River basin.

3.21.3.5 Threatened and Endangered Species

The Instream Structures Alternative would not cause adverse impacts on threatened and endangered species, other than some temporary and minor disturbances to bald eagles during construction. Bald eagles would benefit from an increase in trout populations in the Provo River under this alternative. Therefore, cumulative impacts on threatened and endangered species from the Instream Structures Alternative and interrelated projects would primarily be limited to those caused by the interrelated projects, as described in Section 3.21.2.6 of the WCWEP and DRP EIS.

3.21.3.6 Mineral and Energy Resources

About 155,600 gallons of fuel would be used during the concurrent construction of the Instream Structures Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline).

3.21.3.7 Air Quality

The maximum vehicle emissions during any 12-month period of construction of the Instream Structures Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would be 173 tons of nitrogen oxides, 15 tons of sulfur oxides, and 13 tons of particulates. Fewer cumulative air quality impacts would occur under this alternative after construction since it would attract less recreation-related traffic than the PRRP Proposed Action (Riverine Habitat Restoration) or Existing Channel Modification Alternative.

3.21.3.8 Agriculture

Future cumulative impacts on agriculture from construction of the Instream Structures Alternative and WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would include temporary disruption of production during construction on approximately 220.7 acres of grazing and cropland. There would be a cumulative and permanent loss of about 0.2 acres of grazing land and 10.8 acres of cropland. This would cause the following cumulative production decreases during construction: about 301 AUMs on grazing land and pasture, 1,960 bushels of barley and 547 tons of alfalfa.

The Instream Structures Alternative would not cause a change in production after construction. Therefore, the following cumulative production changes after construction only would be caused by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline): an annual increase of 2,001 AUMs and 2,011 tons of alfalfa, and a decrease of 120 bushels of barley.

3.21.3.9 Socioeconomics

Future cumulative employment, revenue and income impacts would occur during the simultaneous construction of the WCWEP and DRP Proposed Action (WCWEP and Daniel Replacement Pipeline), Instream Structures Alternative and Highway 40 upgrade. The cumulative and peak increase in construction-related employment caused by these 3 projects would be approximately 155 jobs. The WCWEP and DRP Proposed Action (WCWEP and Daniel Replacement Pipeline) and Instream Structures Alternative would cause a reduction in gross farm revenues during construction as land is removed from production. The cumulative loss of gross farm revenue would be about $44,000. Gross revenue in the construction and retail trade sectors would increase. The cumulative and peak annual increase in total Wasatch County revenue during construction would be approximately $653,000.

After construction, there would be a cumulative net increase of about $131,000 in total annual gross revenue in the farm sector of Wasatch County's economy. The retail trade sector of the county would experience an annual increase in gross revenue of about $104,000; therefore, the total increase in the county's gross revenue would thus be approximately $324,000 per year. This would lead to an increase in income, sales tax revenue and income tax revenue. Property tax revenues would drop about $55,000 per year as payments in lieu of taxes from the federal government begin on land that is currently private property.

3.21.3.10 Health and Safety

The cumulative risk of traffic accidents would be lowest under this alternative since it would cause a lower increase in traffic during or after construction than the PRRP Proposed Action (Riverine Habitat Restoration) or Existing Channel Modification Alternative.

3.21.3.11 Recreation Resources

This alternative and the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) would cause a net increase of 204,964 angler days per year of recreational fishing. An additional 10,000 angler days per year would be made possible by the WCWEP and DRP Proposed Action (WCWEP With Daniel Replacement Pipeline) in the upper Strawberry River basin and would help mitigate losses attributed to the Strawberry Aqueduct and Collection System.

3.21.3.12 Transportation

73 During their construction periods, this alternative and interrelated projects would cause a cumulative peak of 468 daily trips on Highway 40 in Heber Valley, 1,032 peak daily trips on Highway 189 in the Provo River canyon, and 232 peak daily trips on Highway 189 in Heber Valley. Cumulative traffic impacts after construction would be less than those associated with the PRRP Proposed Action (Riverine Habitat Restoration) since this alternative would attract fewer recreationists to Heber Valley.

3.22 Irreversible and Irretrievable Commitment of Resources

3.22.1 Introduction

This section describes the irreversible and irretrievable commitment of resources and the potential for conservation that would occur under the Proposed Action (Riverine Habitat Restoration) and alternatives. The general discussion of the types of resources where irreversible and irretrievable commitments would occur for the Proposed Action (WCWEP With Daniel Replacement Pipeline) in Section 3.22.2 of the WCWEP and DRP EIS also applies to the Proposed Action (Riverine Habitat Restoration) and alternatives, which is referred to as the Proposed Action in this subsection.

There would be no irreversible and irretrievable commitment of resources under the Proposed Action and alternatives for the following resources:

- Water resources
- Water quality
- Wetlands
- Aquatic resources
- Wildlife resources
- Threatened and endangered species
- Soil resources
- Air quality
- Health and safety
- Noise
- Visual resources
- Recreation resources
- Cultural resources
- Transportation

3.22.2 Proposed Action (Riverine Habitat Restoration)

Materials used during construction of the Proposed Action would be permanently committed to the project. Table 1-14 in Section 1.11.5 of the PRRP EIS lists materials to be used during construction.

Construction of the Proposed Action would require 142,600 gallons of gasoline for vehicles and equipment. Additional recreational traffic after construction would use more fuel, but the amount is not readily quantifiable.

Some existing, irrigated and non-irrigated agricultural lands would be permanently removed during construction the Proposed Action, including 6.9 acres of grazing land and 153.1 acres of cropland.

Funds used for construction and operation of the Proposed Action will be permanently committed to the project and not be available for other purposes. Table 1-15 in Section 1.11.6 of the PRRP EIS shows estimated construction and operation costs.

3.22.3 Existing Channel Modification Alternative

The irreversible and irretrievable commitment of resources under the Existing Channel Modification Alternative would be generally similar to the discussion in Section 3.22.2 for the Proposed Action (Riverine Habitat Restoration).

Construction of the this alternative would require 106,300 gallons of gasoline for vehicles and equipment. Additional fuel would be used for increased recreational traffic after construction, but the amount is not readily quantifiable.

Some existing irrigated and non-irrigated agricultural lands would be permanently removed during construction the Proposed Action, including 7.6 acres of irrigated pasture and 7.6 acres of cropland.

3.22.4 Instream Structures Alternative

The irreversible and irretrievable commitment of resources under the Instream Structures Alternative would be generally similar to the discussion in Section 3.22.2 for the Proposed Action (Riverine Habitat Restoration), except no agricultural lands would be permanently removed.

This alternative would use about 13,106 cubic yards of gravel from an existing, off-site borrow source for construction.

Construction of this alternative would require about 4,000 gallons of gasoline for vehicles and equipment. Increased recreational traffic after construction would use additional fuel, but the amount is not readily quantifiable.

Provo River Restoration Project

Draft Environmental Impact Statement

Chapter 4
Consultation and Coordination

Chapter 4
Consultation and Coordination

4.1 Introduction

This chapter describes the consultation and coordination for the Provo River Restoration Project (PRRP) Environmental Impact Statement (EIS). It summarizes the scoping process and results of scoping meetings, identifies the agencies and organizations consulted, and describes the coordination that will be achieved in reviewing the Draft EIS. Information in this chapter was summarized from the Scoping Summary Report (CUWCD 1995), which is available from Central Utah Water Conservancy District (CUWCD) upon request.

The CUWCD initiated and managed the consultation and coordination for the PRRP EIS. Agencies, organizations and technical experts were requested by CUWCD to participate on committees and review the environmental analysis and EIS documentation.

Portions of this chapter are the same as presented in Chapter 4 of the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) EIS since consultation and coordination was conducted simultaneously for both projects. Section 4.2, Scoping Process and Results, is the same as Section 4.2 in the WCWEP and DRP EIS except for Section 4.2.2 (Results of Scoping Meetings and Use of Comments Received). Section 4.3, Consultation, is the same as Section 4.3 in the WCWEP and DRP EIS, except that Sections 4.3.1.2, 4.3.1.3, 4.3.1.4, 4.3.1.9 and 4.3.1.10 are not applicable to the PRRP EIS. Additional consultation on this EIS was conducted with agencies and organizations as described in this chapter. Section 4.4, Coordination, is the same as Section 4.4 in the WCWEP and DRP EIS.

4.2 Scoping Process and Results

This section describes the results of scoping meetings and how the comments from those meetings were used.

4.2.1 Results of Scoping Meetings and Use of Comments Received

Public input at the scoping meetings and written comments received from interested citizens and organizations were carefully reviewed and analyzed to determine the issues and concerns. The analysis showed the public and agencies placed high priority on the following resources: socioeconomics, recreation, aquatic resources, wetlands, wildlife resources, agriculture, threatened and endangered species and surface water. Resources of moderate importance included water quality, transportation, soils and groundwater. Issues and concerns about these resources were used to establish the scope of the environmental analysis for the PRRP EIS.

The verbal comments made at the scoping meetings and written comments received by the CUWCD were used to identify specific issues and concerns that are addressed in the environmental analysis. These issues and concerns were restated as questions and used to identify impact topics and methodologies for analyzing impacts on the resources. The questions are listed in each resource section and answered by the impact analyses presented in Chapter 3.

4.3 Consultation

Consultation has been conducted with agencies, organizations and technical experts throughout the environmental analysis and preparation of the EIS. This section describes additional consultation during the PRRP analysis and document preparation.

4.3.1 Agencies, Organizations and Technical Experts Consulted

The following subsection describes the significant consultation during development of the Proposed Action and the EIS.

4.3.1.1 PRRP Technical Advisory Committee. This committee first met on January 14, 1992 to begin project planning that evolved into the PRRP. Its purpose was to bring together the diverse interests of federal, state and local agencies, water users, local elected officials and interested organizations to discuss alternatives for restoring the Provo River between Jordanelle Dam and Deer Creek Reservoir. The committee continued its meetings on April 30, 1992; June 4, 1993; July 7, 1993; October 21, 1993; and March 9, 1994. Members also toured the Provo River on June 3, 1993 and conducted a workshop from July 5 through July 9, 1993. The following agencies and organizations and their representatives participated in the committee:

- U.S. Fish and Wildlife Service — Leon Colborn
- U.S. Army Corps of Engineers — Katherine Trott
- U.S. Forest Service — John Frandsen, Bob Hurley
- U.S. Geological Survey — D. Michael Roark
- U.S. Bureau of Reclamation — David Frandsen
- Utah Division of Wildlife Resources — Mark Holden, Doug Sakaguchi
- Utah Department of Natural Resources — Milo Barney
- Utah Division of Water Resources — Robert King
- Utah Division of Water Rights — Chad Gourley
- Wasatch Soil Conservation District — Claude Hicken, Jack Young
- Wasatch County Commission — Morroni Besendorfer
- Wasatch County — Bob Mathis
- Wasatch County Special Service Area — LeeRoy Farrell
- Provo River Canals Commission — Robert Fillerup
- Midway City — Reed Bezzant
- Provo City Water Resources — Merril Bingham
- Municipal Water District of Salt Lake City — Nick Setakis
- Salt Lake County Water Conservancy District — David Ovard
- Utah Outdoor Interests Coordinating Council — Jeffrey Appel, Paul Dremann, Dan Potts, Darrell Mensel
- Provo River Water Users Association — Jack Gardner
- Wasatch County Water Users — George Holmes
- Summit County Water Users — Ed Lire
- Franson Noble — Rick Cox
- Inter-Fluve, Inc. — Scott Gillilan, Bob O'Brien
- Don Chapman Consultants — William Platts

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Glossary

100-Year flood. A flood that occurs, on average, once in 100 years and has a 1 percent chance of occurring in any given year.

6W Lands. Saturated lands or open water classified as unsuitable for irrigation under the U.S. Bureau of Reclamation Land Classification System.

Accretion. The gradual accumulation of water in a surface or subsurface body of water.

Acre-feet. A unit of measurement of volume of water, equivalent to an acre of water 1 foot deep.

Affected environment. Parts of the environment that would be impacted by a change in operation or management.

Afterbay. A man-made area into which a pumping station pumps or a dam discharges water.

Agricultural practices. The procedures used to produce crops, including such operations as planting, fertilization, pesticide application, cultivation, irrigation and harvesting.

Algorithm. A mathematical formula using several variables or attributes.

Alluvial soils. Soils formed by flowing water.

Alternative. A proposition or situation offering a choice between two or more proposals, only one of which may be chosen. An opportunity for deciding between two or more courses or propositions.

Angler day. One person fishing for 2.6 hours.

Animal unit month (AUM). The amount of feed or forage required by one animal for 1 month, which is equivalent to the average monthly forage consumption of 800 pounds of dry matter.

Aquatic ecosystem. Waters of the United States, including wetlands that serve as habitat for interrelated and interacting communities and populations of plants and animals.

Aquifer. A subsurface body of water.

Arachnids. Class of arthropods containing spiders, mites, ticks and scorpions. They have no antennae, and the front half of the body bears four pairs of legs.

Attribute. A characteristic of the aquatic habitat (e.g., late summer streamflow and eroding channel banks) that is given a numerical rating based on a field evaluation. The rating is used to compute a score using the Binns HQI (Habitat Quality Index) model (see description below).

Avulsion. A sudden, natural change in river alignment that occurs most often when major flood flows break through channel banks and flow into lower areas.

Background distance zone. The distant part of a landscape, picture, etc.; surroundings, especially those behind something and providing harmony or contrast; surrounding area or surface. Area located from 3 to 5 miles to infinity from the viewer.

Bankfull. Water flowing in a channel at the elevation of the channel banks. Any additional discharge would cause water to begin overflowing from the channel.

Baseline. The set of starting conditions from which changes and impacts are quantified.

Bed load. Material (e.g., sands, gravels and cobbles) transported by flowing water that moves and interacts with the channel bed.

Benthic macroinvertebrates. A group of small aquatic insects, crustaceans and worms typically found in the substrate (mud, sand, silt, gravel, cobble and boulders) of a stream or body of water.

Binns HQI Model II. A method of calculating a score that measures existing stream habitat quality for trout and estimates potential trout production resulting from improvements in habitat quality attributes.

Biomass. A measurement of the weight of living organisms per unit area.

Booster station. An pump station along a canal or pipeline used to raise water to a higher level or pressure.

Buffer. Space adjacent to the channel or other project feature where activities that could adversely impact the feature would be restricted.

Calibration (of a model). The process of adjusting simulation model parameters to more accurately mimic the prototype system.

Canal checks. Structures placed in a canal to control the hydraulics of the flow.

Canal cross-section. A view of a canal looking laterally into the direction of flow.

Canal rupture. A break in a canal embankment resulting in uncontrolled spillage of water.

Capital program. A plan of a government agency or other entity to spend money in the future, usually for physical facilities such as utilities, buildings, streets and roads.

Carrion. Decaying remains of an animal.

Channel geometry. Physical characteristics of the channel cross-section (bottom width, top width, depth, side slopes).

Check dam. A structure placed in a stream or water conveyance facility to control the hydraulics of the flow.

Cofferdam. A temporary dam or diversion structure formed in the channel to isolate certain areas and keep them relatively dry during construction.

Community well-being. A term used in social impact assessment to describe how satisfied or happy the members of a community are. A community's well-being is influenced by the overall level of conflict between the community's social groups and can be affected by impacts on its members' lifestyles, behavior, attitudes and values.

Colony. A group or cluster of individuals of a species living together.

Complexity. The diversity and variability in stream habitat; the presence of different kinds of structure in a stream (e.g., root wads, logs, cover and depth) that contribute to increased habitat diversity.

Condemnation. A legal process involving the acquisition of private property by a government agency.

Conductivity. A measurement of the degree to which a body of water transmits an electric current.

Confluence. The location where two or more streams come together.

Contingent valuation. A methodology for measuring the dollar value of a particular resource, usually environmental benefits. A useful way to measure intangible benefits of a project, it often involves conducting a survey to identify the value placed on a resource by a target group. The surveys are used to measure the amount of money individuals would be willing to pay in return for a given quantity or quality of that resource over a specified period of time.

Control structure. A structure placed in a stream or conveyance facility to control the hydraulics of the flow.

Conveyance losses. The portion of the flow through a conveyance facility that does not reach the delivery point.

Council on Environmental Quality (CEQ). An advisory council to the President of the United States established by the national Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Creel census. A determination of fish catch success based on interviews with anglers.

Cross drainage. Surface flow from rainfall, snowmelt or irrigation drainage that flows across or enters irrigation facilities.

Crop enterprise approach. The use of "cost of production" budgets to estimate the costs to grow and harvest a particular crop and the gross revenue from selling the harvested portion. Gross revenue less cost of production provides an estimate of the profitability from crop production.

Cropping pattern. The acreage of crops by crop type grown annually in succession on the same area of land.

Crop yield. The amount of harvest per acre for a particular crop for 1 year.

Crustaceans. A large subphylum (or class) of arthropods typically having two limbs and two pair of antennae (e.g., crabs, lobsters and shrimps).

Cumulative impacts. As defined in Section 1508.7 of the Council on Environmental Quality (CEQ) Regulations (CEQ 1978), cumulative impacts are "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

CUWCD Service Area. The area provided water by Central Utah Water Conservancy District (CUWCD).

Decibel. A unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to 130 for the average pain level.

Delivery rate. The volume of water delivered per unit of time.

Depositional structure. A rock or log structure placed in a channel to encourage bed material (sands, gravels and cobbles) to drop from flowing water and be deposited in selected locations.

Diversion dam. A structure across a main river channel that maintains the channel bottom elevation and increases the water surface elevation just downstream of a diversion structure to improve the performance of the diversion.

Diversion. Taking water out of a stream and putting it into a pipeline, canal or reservoir.

Dominant species. A plant species that exerts a controlling influence on or defines the character of the plant community.

Dynamic equilibrium. The self-regulating state of a physical system wherein negative feedback counteracts the effects of external change so the system returns to a state of equilibrium.

Easement. A partial ownership of land providing the owner access or other rights to certain uses of the parcel.

Ecosystem. A community of animals and plants and their interrelated environment.

Effectiveness. The capability of a wetland to perform a function due to its physical, chemical and biological attributes. Effectiveness does not estimate the magnitude of a wetland function, but the probability that a wetland will perform the function.

Elements (of a model). Homogeneous units of aquifer material represented in the model.

Emergent marsh. A meadow-like area overgrown with herbaceous aquatic plants such as cattail, rushes and sedges.

Emergent vegetation. Erect, rooted, herbaceous vegetation (excluding mosses and lichens).

Eminent domain. The right of the government to take private property for public use, with just compensation provided to the owner.

Emission. Substances discharged into the air (as by automobiles or construction equipment engines).

Endangered species. Any species of plant or animal that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Environmental Impact Statement (EIS). A document that discusses the likely significant impacts of a proposal, methods to lessen the significance of impacts, and alternatives to a proposed action. This documentation is required by the National Environmental Policy Act.

Equilibrium temperature. The temperature that a body of water would reach if all meteorological conditions were constant over time.

Erodibility. The susceptibility of a land surface to the carrying away of soil material by wind or water.

Eutrophication. The process of over-enrichment of water bodies by nutrients often typified by the development of algae blooms.

Evapotranspiration. Loss of water from the earth's surface to the atmosphere through the processes of evaporation and transpiration (movement of water from the soil through plants to the atmosphere).

Fee title acquisition. Acquiring total, unrestricted ownership of a parcel of land.

Filter strip. A relatively narrow area of vegetated land that filters out suspended solids or other water quality parameters.

Fiscal resources. The funds of federal, state and local agencies, including revenue from various tax sources, that is used to fund public goods and services. These often include sales, use, property and income taxes. They may also include measures of the ability to borrow money or obtain grant funds.

Floodplain. The area covered by floodwaters from channel overflows; generally associated with a particular recurrence interval (e.g., the 100-year floodplain is the area covered by floodwaters from the 100-year flood).

Flow-weighted mean concentration. Average concentration of a pollutant in a stream or river, adjusted for the effects of flow.

Freeboard. The distance between the normal operating water surface in a canal and the top of the canal embankment, usually designed to be a minimum of 6 to 12 inches. Freeboard allows water depth to increase in a canal during an emergency without spilling over the bank until the water returns to the normal level.

Functions. The physical, chemical and biological processes or attributes of a wetland regardless of their importance to society.

Gage. A measuring device or location usually associated with water levels.

Game species. Any species of wildlife or fish that have seasons and prescribed bag limits and are normally harvested by hunters, trappers and anglers under state or federal laws, codes and regulations.

Geomorphology. The study of how various land forms are sculpted by surface agents such as wind and flowing water.

Geotextile. Fabric used in construction applications for separation layers, load-bearing increasers, filters, impermeable layers, soil retention and weed control.

Gradient. The slope of a streambed or groundwater level.

Grazing patterns. A system of livestock grazing management that includes the following approaches: 1) rest-rotation, in which grazing is deferred on various parts of the range during succeeding years, allowing those areas to rest for one year; 2) rotational, which uses periods of heavy pasture stocking followed by periods of rest during the same season; and 3) strip grazing, which confines animals to an area of forage to be quickly consumed.

Gross revenue. Receipts from economic activity before adjustments for taxes and the cost of doing business.

Groundwater discharge. The movement (usually laterally or upward) of water from a body of groundwater to its emergence into a surface water system such as a spring, seep or stream channel.

Groundwater recharge. A condition in which the volume of water entering underlying terrestrial environments exceeds the volume discharging to the wet depression on a net annual basis.

Groundwater. Water beneath the surface that feeds wells and springs and maintains the level of rivers and lakes in dry weather.

Growing season. The portion of the year when soil temperatures at 19.7 inches below the soil surface are higher than biologic zero (5° C) (U.S. Department of Agriculture — Soil Conservation Service 1985); approximately the number of frost-free days (U.S. Department of the Interior 1970).

Growth-inducing forces. Factors that can cause growth or economic development, including employment opportunities, affordable housing and land, plentiful resources such as water and energy, and favorable zoning and tax policies.

Habitat. The place or type of site where a plant or animal naturally or normally lives and grows.

Headcut. A nearly vertical drop along a stream or canal that tends to erode upslope.

Headwall. The vertical surface at the upstream end of a canal.

Health and safety hazard. Something that could harm people or is a danger to the health and safety of people.

Historic archaeological site. Historic manifestation of human activity such as foundations and trash scatters.

Historic standing structure. A historic standing building with walls and roof still intact; also intact engineering structures such as bridges and culverts.

Hobby farms. A term used to describe farms that are usually small and not the primary source of income for their owners

Hydrology. A science dealing with the properties, distribution and circulation of water.

Income. A standard gauge of economic activity that measures personal earnings generated by workers before any adjustments for taxes or other costs of living.

Infiltration. The movement of water into the soil surface.

Ingress and egress. The movement of workers and equipment into and out of the construction area.

Instream flow. The volume per unit of time (often cubic feet per second) of water flowing within a stream channel.

June sucker. A threatened fish species found in the lower Provo River.

Jurisdictional wetlands. Wetlands that meet federal criteria for hydrology, soils and vegetation and are regulated by the U.S. Army Corps of Engineers.

Kilowatt hour. A unit of energy equal to 1,000 watts for one hour.

Land use. The types of activities allowed on land (e.g., agriculture, residences and industry). Certain types of pollution are often associated with certain land uses, such as sedimentation from construction or farming activities.

Laterals. Smaller ditches or canals off of a main canal, which carry water to the fields.

Long-term impact. A general term used to describe impacts that continue after completion of project construction. The length of time they continue can vary.

Low flow. The annual minimum flow observed in a stream.

M & I (municipal and industrial) water. Water provided for urban land uses such as residential, commercial and industrial as opposed to agricultural.

Macroinvertebrate. Animals in a stream that lack a backbone and typically consist of aquatic insects, worms and other small animals that are large enough to see with the unaided eye.

Mapping unit. A common characteristic of soil, vegetation or hydrology that is used for mapping existing wetlands within the impact area of influence.

Meander. A bend in the channel alignment of a river or stream.

Mesotrophic. A lake or reservoir classification with moderate nutrient inputs and moderate algae production.

Middleground distance zone. The space between the foreground and the background in a picture or landscape. The area located from one-quarter to one-half to three to five miles from the viewer.

Migratory. An animal that shifts from one habitat to another by season.

Millimho (mmhos). A unit of electrical conductance.

Mitigate, mitigation. Cause to become less severe or harmful; reduce impacts; actions to avoid, minimize, reduce, eliminate or rectify impacts to resources.

Mixing status. The frequency of complete vertical lake or reservoir mixing (i.e., dimictic mixes twice a year, while polymictic mixes several or more times per year).

Mixing zone. A limited volume of water serving as a zone of initial dilution at the location of a discharge point where receiving water quality may not meet water quality standards.

Mollusks. *Mollusca*, a phylum of unsegmented, generally shelled and bilaterally symmetrical invertebrates with a muscular foot for digging, swimming or creeping (e.g., snails, mussels, etc.).

Monitor. To systematically and repeatedly measure conditions in order to track changes.

Morse Decree. A 1921 legal decision that established water rights for irrigation diversions in Heber Valley, Utah.

Mulch. A protective covering spread or left on the ground to reduce evaporation, maintain even soil temperature, prevent or reduce erosion, control weeds and enrich the soil to enhance establishment of vegetation.

Non-jurisdictional wetlands. Wetlands that do not meet federal criteria for hydrology, soils and vegetation and are not regulated by the U.S. Army Corps of Engineers.

Noxious weeds. A plant species that is undesirable, conflicts, restricts or otherwise causes problems with intended land-use goals and objectives.

Nutrients. Essential chemicals needed by plants or animals for growth and health. If other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth and accumulation and decay of plants, especially algae. Some nutrients can be toxic to animals in high concentrations.

Open-water. Open-water wetland classification includes water of any depth with at least 7 linear feet and 49 square feet of surface area and no upright vegetation. If adjacent vegetation is mostly woody, the surface area requirement increases to 200 linear feet and 2,000 square feet. Open water includes channels, deep water, and wetland areas with submerged vegetation.

Organic riprap. Organic material used to prevent channel bank erosion (e.g., tree trunks, root wads and willow stakes).

Palatability. Agreeable to the sense of taste.

Passerines. Song birds.

Peak annual gross revenue. The largest amount of gross receipts expected to be generated during a 12-month period, typically used to gauge economic impacts caused by the peak workforce during construction of a project.

Peak annual income. The largest amount of earnings expected to be generated during a 12-month period, typically used to gauge economic impacts caused by the peak workforce during construction of a project.

Peak discharge. Maximum flow rate, usually reported in cubic feet per second (cfs).

Per capita income. A measure of how much money is earned on average by each person in a given geographic area such as a county or state.

Percolate, percolation. The downward movement of water through soil.

Permanent impact. An impact caused by construction of new facilities or project features that will not be removed during the life of the project (e.g. land removed from some current use and covered by a canal, pump station, river channel, etc.).

Phreatophytes. A plant with a deep root system that obtains water from the groundwater or the capillary fringe above the water table.

Piciformes. Woodpeckers.

Pipeline rupture. A break or separation in a pipeline resulting in uncontrolled spillage of water.

Pollination. To place pollen on the stigma of a flower.

Pollutant loadings. The mass of a given pollutant that enters a body of water in a specified time period (i.e., kilograms per year).
Polarization. A term used in social impact assessment to describe the separation of social groups or members of a community, or an increase in conflicts between social groups or institutions.

Pour-over. A local channel feature comprised of boulders or large cobble, usually in a riffle or rapid, which causes water to "pour over" and undergo a short, relatively sudden drop in elevation.

Prehistory. The study of the life and activities of mankind up to the beginning of recorded history.

Pressure reducer. A valve used to reduce the pressure in a pipeline.

Prey. An animal or animals seized as food by another animal.

Prime farmland. Lands that have the best combination of physical and chemical characteristics for the production of food, feed, forage, fiber and oilseed crops. Prime farmlands in Utah are defined to have the following characteristics; 1) a water supply adequate to meet 7 of 10 years irrigation requirements; 2) summer soil temperatures warmer than 59 degrees F at a depth of 20 inches; 3) a pH value between 5.5 and 8.6 above a depth of 20 inches and alkali content less than 15 percent; 4) a water table that does not restrict the production of food, feed and forage crops; 5) no significant salt content in the upper 20 inches; 6) no flood hazard nor flooding more than once in two years; and 7) minimal erosion danger (SCS 1983).

Productivity. A measure of how much of an agricultural commodity is yielded by agricultural land.

Projectile points. Pointed projectiles usually made of chipped stone, used 10,000 years ago as spear points and more recently as dart and arrow points.

Proposed Action. The proposal or proposed project by a lead agency in an environmental impact statement.

Pump station. A pump or set of pumps usually used to move irrigation water.

Radial gates. Hydraulic control structures that are raised or lowered radially to increase or decrease the flow in a channel.

Rapid-pool channel. Similar to a step-pool channel but with rapids rather than steps to generate most of the drop in channel elevation.

Raptor. A bird of prey.

Reach. A defined length or segment of a stream.

Real-time monitoring. Instantaneous receipt of information from a remote site that represents what is occurring at the time.

Reclamation. Returning disturbed land to a form and productivity that is ecologically balanced and in conformity with a predetermined goal and land-use objective.

Record of Decision. A document separate from but associated with an Environmental Impact Statement that publicly and officially discloses the responsible official's decision on which alternative assessed in the Environmental Impact Statement to implement. It also includes commitments to mitigation.

Recurrence interval. Frequency with which a flood event would occur, measured in years (e.g., a flood with a 100-year recurrence interval would occur on average once in 100 years).

Regulating pond. A pond used to provide a more uniform water level or downstream flow of water.

Rehabilitation. Restoring an area or structure to its previous condition.

Reproductive success. The ability of two animals of the same species to produce fertile offspring.

Retention coefficient. A coefficient without dimension that reflects the annual fraction of total phosphorus sedimented or retained in a lake or reservoir.

Return flow. The flow of unconsumed water back to the stream, river or reservoir after delivery; often used to describe groundwater discharge to surface water.

Riffle-pool (C-type) channel. A channel comprised of a series of alternating riffles (shallow, faster-flowing sections) and pools (deeper, slower-flowing sections), usually having a meandering alignment. This is classified as a C-type channel in Rosgen's Stream Classification System.

Riparian. Refers to features of the environment (e.g., vegetation types) living in, or located on, the bank of a natural watercourse such as a stream or river.

Riverine. Flowing fresh waters (salinity less than 0.5 parts per thousand) with less than 30 percent persistent vegetation cover; of, or relating to a river.

Rock deflector. A large rock placed in the channel to deflect flows from the channel bank or other sensitive area to reduce the effect of erosion forces.

Roost. A place where birds rest and sleep.

Rotenone. A plant-derived, crystalline pesticide that has low toxicity to warm-blooded animals (i.e., mammals) and relatively high toxicity to aquatic organisms (i.e., fish). Rotenone was applied to the Strawberry Reservoir to non-selectively kill all fish in the reservoir.

Rush. A plant with cylindrical often hallow stems, that grows in marshes and wetlands.

Salinity concentrations. The amount of soluble salts contained in the soil, usually measured by the electrical conductivity of water removed from a soil paste under vacuum.

Sectors. The components or categories that an economy is divided into; they are often referred to as industrial sectors and include the construction, retail trade, service, manufacturing and agricultural sectors. The U.S. Department of Commerce has established standard economic sector definitions for measuring and reporting economic activity.

Scoping. The process used to determine the public's concerns and other input regarding proposed activities assessed in a National Environmental Policy Act (NEPA) document.

Scrape. A simple, shallow nest constructed by scraping an indentation into surface material such as soil or loose gravel.

Secondary irrigation system. A water distribution system that provides irrigation water separate from a primary potable water system.

Sedge. A grass-like, tufted plant that grows in wet areas.

Sediment. Material suspended in or settled to the bottom of a liquid from natural sources such as soil erosion or rock weathering or from human activity such as forest or agricultural practices or construction. Certain contaminants tend to collect on and adhere to sediment particles.

Sedimentation. The introduction of sediment material from an erosion source into a stream or lake.

Seeps. Areas where groundwater leaks onto the surface but doesn't create a defined channel

Sensitive receptors. Locations especially susceptible to noise impacts, such as schools, hospitals, nursing homes and residences.

Setback levee. A levee or dike that is set back from the channel bank and used to limit flooding from channel overflows.

Short-term impact. An impact that occurs during construction and does not continue beyond completion of construction (e.g., increased dust, noise, traffic, etc.).

Sill. A solid feature (typically concrete, wood or rock) extending across a channel to prevent down-cutting of the channel and maintain the bottom elevation at a given level; similar to a diversion dam.

Siltation. The process of introducing fine-particle materials to a stream, which then cover larger substrate particles that often is quality gravel substrate critical for trout habitat.

Social groups. A term used in social impact assessment to describe groups of people that form a community and would be affected by a project in a similar manner. The groups are not mutually exclusive; some individuals have interests and concerns that place them in more than one group. The members of each social group would likely experience common impacts on their lifestyles, behavior, attitudes, values and general well-being.

Socioeconomics. The resource topic or discipline that addresses potential impacts of a project on people and affected economies. Specific topics of analysis include impacts on businesses, personal income, employment, public services and fiscal resources of government agencies, housing, population and demographics, and social impacts.

Soil chemistry. The chemical makeup of the soil mass that includes such chemical constituents as reaction (pH), soluble and insoluble salts and minerals.

Soil quality. The combination of physical and chemical soil characteristics that determines the suitability for the production of food, feed, forage, fiber and oilseed crops.

Soil stability. The ability of a soil mass to resist the forces of wind and water erosion.

Soil stratification. Soil materials deposited by water, wind or formed in place, and commonly found in layers with different physical and chemical properties.

Soil texture. The relative proportions of sand, silt and clay particles in a mass of soil.

Spillway. A structure in a dam or canal that allows water to overpour at a controlled location when water levels reach a maximum allowable level.

Standard deviation. A measure of the variation of sampling data.

Standard Operating Procedures (SOPs). A process followed during construction, operation or maintenance of a project to avoid, minimize or rectify adverse impacts on natural resources and people.

Standing crop. The biomass of a particular group or groupings of organisms present at any one time (i.e., total weight of trout species in a stream).

Step-pool (B-type) channel. A channel comprised of a series of alternating steps (nearly vertical drops in the channel bottom) and pools (deeper, slower-flowing sections), usually having a relatively straight alignment. This is classified as a B-type channel in Rosgen's Stream Classification System.

Stratification. Layering of water caused by differences in water density.

Stream gage. A structure or device used to measure the flow of water in a stream or canal.

Substrate. Sediment particles that make up the stream or lake bottom. The classification or categorization of sediment particles present within a stream, lake or body of water includes; silt, sand, gravel, cobble and boulders.

Sump structure. A holding area into which water is drained or from which water is pumped.

Supervisory monitoring system. Electronic equipment attached to pumping stations and water control structures that record the position and status of canal gates, pumping rates, etc. and transmit the information through radio signal, telephone line, satellite or direct cable to a remote site such as a central office.

Supplemental instream flow. A water supply provided to supplement the flow of a stream.

Supplemental water. A water supply provided to supplement a prior water supply.

Surface water. Water above the ground surface that is visible to the unaided eye, whether in channels, diffuse flow or standing; not necessarily permanent.

Talus. Loose deposit of angular rock, usually formed by the erosion of a rock cliff above the deposit.

Temporary impact. An impact that lasts for a limited time.

Temporary easements. A partial ownership of land providing the owner temporary access or other rights to certain uses of the parcel.

Thalweg. The point of maximum depth in a channel.

Threatened species. Any animal or plant species likely to become endangered within the foreseeable future throughout all or significant portion of its range.

Total phosphorus. The sum of all forms of phosphorus in water, including dissolved and particulate; usually expressed as a concentration with units of milligrams of phosphorus per liter of water (i.e., mg/L).

Total suspended solids. The amount of particulate matter larger than 0.45 micrometers suspended in water; usually expressed as a concentration with units of milligrams of suspended solids per liter of water (i.e., mg/L).

Transbasin diversion. A water diversion from one hydrologic drainage basin to another.

Trashrack. A screen-like structure used to keep debris out of a pump station or conveyance system.

Tributary. A stream that flows into a large stream, river or other body of water.

Trout production. A measurement of the amount of trout biomass produced per unit area of a stream or body of water. Production usually is stated in terms of an element of time (e.g., pounds of trout per acre per year).

Upland. Any area that does not qualify as a wetland because the associated hydrologic regime is not wet enough to elicit development of vegetation, soils, and/or hydrologic characteristics associated with wetlands. Such areas occurring within floodplains are called non-wetlands.

Vertebrate. Species possessing a spinal column and more or less bony parts of an internal skeleton.

Vortex rock weir. A grade control feature extending across a channel comprised of interlocking boulders which is convex facing upstream and depressed in the center of the channel. It is designed to hold grade- and direct-flow energy toward the center of the channel and away from the banks.

Water rights. A legal right to take water and put it to beneficial use.

Water table. The upper surface of groundwater or the level below which the soil is saturated with water. It is at least 6 inches deep and persists in the soil for more than a few weeks.

Waterfowl. Any bird that frequents rivers and lakes, especially a swimming bird.

Wetland functions. The physical, chemical and biological processes or attributes of a wetland without regard to their importance to society.

Wetland hydrology. The sum total of wetness characteristics in areas that are inundated or have saturated soils for a long enough time to support vegetation that requires large amounts of water to grow.

Wetlands. Areas that are inundated by surface or groundwater often enough to support — and under normal circumstances does or would support — vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wetted channel. The portion of the streambed that conveys water.

Wheeling. Conveyance of one owner's water through another owner's conveyance facilities.

Acronyms and Abbreviations

Acronym	Description
1987 EIS	USBR's 1987 Supplement to the Final EIS on the CUP Municipal and Industrial System, Bonneville Unit
6W	USBR Land Classification System
AADT	Annual Average Daily Traffic
AUM	Animal Unit Month
BLM	Bureau of Land Management
C-1	Category-1
C-2	Category-2
CEQ	Council on Environmental Quality
COE	U.S. Army Corps of Engineers
CRSP	Colorado River Storage Project
CUP	Central Utah Project
CUPCA	Central Utah Project Completion Act of 1992
CUWCD	Central Utah Water Conservancy District
DIC	Daniel Irrigation Company
DOI	U.S. Department of the Interior
DPR	Daniel Replacement Project
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EWPE	Eckhoff, Watson and Preator Engineering
FWCA	Fish and Wildlife Coordination Act
FWS	U.S. Fish and Wildlife Service
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HCSS	Heber City Secondary System
HL&P	Heber Light & Power
HQI	Binns Habitat Quality Index (model)
JTAC	Jordanelle Reservoir Water Quality Technical Advisory Committee
M&I	Municipal and Industrial
Mitigation Commission	Utah Reclamation Mitigation and Conservation Commission
mmhos/cm	millimhos per centimeter
MODFLOW	USGS Three-Dimensional Finite Difference Groundwater Model
NAS	National Academy of Sciencies
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
O&M	Operation and Maintenance
PMF	Probable Maximum Flood

PMOA	Programmatic Memorandum or Agreement
PROSIM	Provo River Simulation Model
PRRP	Provo River Restoration Project
PRWUA	Provo River Water Users Association
PVC	polyvinyl-chloride
ROD	Record of Decision
ROW	rights-of-way
SCS	Soil Conservation Service
SFN	Spanish Fork Canyon - Nephi Irrigation System
SHPO	Utah State Historic Preservation Office
SLOW	Selected Level Outlet Works
SOPs	Standard Operating Procedures
SSA	Special Service Area
T&E	Threatened and Endangered
UACRs	Utah Air Conservation Rules
UDEQ	Utah Department of Environmental Quality
UDNR	Utah Department of Natural Resources
UDOT	Utah Department of Transportation
UDP&R	Utah Division of Parks and Recreation
UNHP	Utah Natural Heritage Program
US	United States
USBR	U.S. Bureau of Reclamation
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WCSSA	Wasatch County Special Service Area
WCWEP	Wasatch County Water Efficiency Project

Abbreviation	Meaning
/	per
@	at
Ac	acre
ac-ft	acre-foot (feet)
cfs	cubic feet per second
Co.	company
cu yds	cubic yards
db	decibel
dBA	A-weighted decibels
e.g.	example
ft	foot or feet
gpm	gallons per minute
hp	horsepower
i.e.	such as
in.	inch
kg/ac/yr	kilogram per acre per year
kg/yr	kilograms per year
kwhr	kilowatt-hour
kwhr/yr	kilowatt-hours per year
lb	pound
lbs	pounds
lin ft	lineal feet
mg/L	milligrams per liter
mi.	mile(s)
NO_3	nitrates
NOx	nitrogen oxides
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter
psi	pounds per square inch
SOx	sulfur oxides
sq ft	square feet
TP	total phosphorus
TSS	total suspended solids
w/	with
yr	year
Yr	Year
µg/L	micrograms per liter
° C	degrees Celsius
° F	degrees Fahrenheit

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Appendix A

Noxious Weed Control Plan

Appendix A
Noxious Weed Control Plan

A.1 Introduction

Noxious weed control is an important component of the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) and the Provo River Restoration Project (PRRP). Construction of these projects would disturb a number of acres providing the opportunity for noxious weed invasion. The State of Utah maintains a list of noxious weeds and a mandate that these plant species be controlled on public and private lands under Section 4-17-3 of the Utah Noxious Weed Act. This appendix describes noxious weeds that are present in Heber Valley and could invade areas disturbed by construction activities, and provides a plan for preventing the spread of noxious weeds under the WCWEP and DRP and the PRRP.

A.2 Noxious Weeds in Heber Valley

This section briefly describes the noxious weeds that can occur in Heber Valley and notes locations where weeds have been identified.

A.2.1 Canada Thistle *(Cirsium arvense)*

Canada thistle is an aggressive colony-forming perennial herb with deep and extensive deep-seated, horizontal rooting patterns. It is characterized by alternate, oblong or lance-shaped leaves divided into spiny-tipped irregular lobes with purple flower heads that appear in late summer. It is a difficult weed to control; breaking up the roots by plowing or disking increases the number of plants by spreading the roots.

Canada thistle is prevalent in some areas of the Heber Valley. There are documented locations along the upper reaches of the Provo River below Jordanelle Dam (Jones 1995; Young 1995).

Control of Canada thistle is especially important in areas that support habitat for Ute ladies'-tresses because the thistle forms thick monocultures that out-compete the orchid. There are documented orchid colonies at the upper end of the Provo River below Jordanelle Dam.

A.2.2 Scotch Thistle *(Onopordum acanthium)*

Scotch thistle is an drought-tolerant, aggressive, biennial weed that grows up to 8 feet tall. Distinctive characteristics include: stems with broad spiny wings; large spiny, grayish-colored leaves covered with fine, dense hair and numerous flower heads with one to 2-inch diameter violet to reddish flowers. The basal leaves may grow up to 2 feet long and one foot wide.

This plant has spread into sagebrush, riparian, aspen and other native plant communities where it competes successfully with indigenous plant species. It is especially well adapted to livestock bed-ground and trail sites.

A.2.3 Musk Thistle *(Carduus nutans)*

Musk thistle is an aggressive coarse biennial or sometimes a winter annual herb that grows up to 6 feet tall. Identifying characteristics include: tap-root, deeply-lobed, dark green leaves with light green midrib and spiny margins; disc flowers are deep rose, violet or purple, sometimes white. Musk thistle is a common invader of pastures, range and forest lands, waste areas, ditch banks, stream banks, and grain fields. Musk thistle can be chemically controlled, but requires persistent spraying. Since the plants reproduce only through seeds produced every other year, the best control method is to cut the young plants off below the ground level. Scotch thistle is known to occur on the Walker property and the Condie properties (Jones 1995; Young 1995).

A.2.4 Yellow Starthistle *(Centaurea solstitialis)*

Yellow starthistle is an aggressive annual or biennial growing 2 to 3 feet in height. Distinguishing characteristics include: deeply lobed white basal leaves, sharp, entire upper leaves; slender rigid stems covered with cottony youth; yellow flowers appear in mid-summer and sharp yellow spines up to 3/4-inch long extend from the seed case immediately beneath the flower.

Starthistle has been identified in the northern reaches of the Provo River corridor below Jordanelle Dam (Young 1995). It can be poisonous to horses.

A.2.5 Spotted Knapweed *(Centaurea maculosa)*

Spotted knapweed is a short-lived, tap-rooted, biennial or perennial with one or more branched stems growing 1 to 3 feet tall. It produces single ray-flowers at the ends of branches that are pinkish purple in color. Knapweeds readily establish on any disturbed soils and their early spring growth makes them compete with other more desirable plants for moisture and nutrients. This species rarely invades indigenous plant communities.

A.2.6 Squarrose Knapweed *(Centaurea virgata)*

Squarrose knapweed is a long-lived tap-rooted perennial that grows 12 to 18 inches in height. Stems are branched with deeply dissected lower leaves and bract-like upper leaves. Flower heads are small, producing 4 to 8 rose or pink colored flowers, and developing 3 to 4 seeds per head.

A.2.7 Leafy Spurge *(Euphorbia esula)*

Leafy spurge is an aggressive perennial herb growing up to 3 feet tall reproducing by vigorous rhizomes and seed. The lower leaves are narrow, strap-shaped approximately 2-inches long; the upper leaves near the flowers are opposite and broadly heart-shaped. Small flowers are yellowish-green, arranged in numerous small clusters. The entire plant contains milky juice. Seeds are oblong, grayish to purple, contained in a 3-celled capsule, each containing a single seed. The capsules explode when dry, often projecting seeds as far as 15 feet. Seeds may be viable in the soil for up to 8 years. Leafy spurge has an extensive root system containing large nutrient reserves making the plant extremely difficult to control and eradicate.

A.2.8 Whitetop *(Cardaria drabra)*

Whitetop (also called Hoary cress) is a white-hairy deep-rooted perennial growing up to 2 feet tall, reproducing from rhizomes and seeds forming dense clones. The stems are about one foot tall, with several branches bearing dense clusters of small white flowers. The branches grow nearly all the same height, giving the plant a flat-topped appearance. Fruits look like small inflated hearts. The toothed leaves clasp the stem and have ear-like lobes. Plants emerge in early spring and have bloomed and set seed by mid-summer. Whitetop can be controlled effectively with herbicides.

A.2.9 Poison Hemlock *(Conium maculatum)*

Poison Hemlock is a coarse, extensively branched perennial that grows to over 6 feet in height. Purplish-red spots mark the erect, strong, hallow stems. Leaves are shiny green, parsley-like or fern-like in appearance and have enlarged petioles that clasp the stem. Each plant has numerous umbrella-shaped clusters of very small white flowers. The plant is deadly poisonous to humans.

A.2.10 Purple Loosestrife *(Lythrum salicaria)*

Purple loosestrife is a rhizomatious perennial with erect stems, growing to a height of 6 to 8 feet. Leaves are opposite or whorled. The flowers are rose-purplish and have 5 to 7 petals arranged in long vertical racemes. Purple loosestrife thrives on moist sites and can completely choke out wetlands and other aquatic vegetation. Infestations can grow so dense that water flow in canals, ditches and streams is impeded. This weed is not listed on the Utah Noxious Weed List, however, it should be controlled especially along ditches, canals, the Provo River and other waterways where it could become a significant problem.

A.3 Plan for Noxious Weed Control

This section presents a plan for preventing the spread of noxious weeds under the WCWEP and DRP and the PRRP.

A.3.1 Seeding

Seeding would be the best method to guard against a significant invasion of noxious weeds on areas disturbed by construction of the WCWEP and DRP and the PRRP. The objective of seeding would be to establish a cover of desirable plant species as quickly as possible after the completion of construction. Interim seeding of topsoil stockpiles and areas that would remain barren for more than a one-month period would be necessary. Permanent seeding of disturbed soils would be conducted at the completion of earth-moving activities. Table A-1 lists plant species for seeding areas disturbed by construction activities. These species should be used in a dry land seed mixture to provide a cover of desirable plants.

Table A-1
Plant Species for Seeding Areas Disturbed by Construction Activities

Common Name	Scientific Name (Synonyms)
Crested wheatgrass	*Agropyron desertorum*
Intermediate wheatgrass	*Agropyron intermedium (Thinopyrum intermedium)*
Pubescent wheatgrass	*Agropyron trichophorum (Thinopyrum intermedium)*
Bluebunch wheatgrass	*Agropyron spicatum (Pseudoroegneria spicata)*
Smooth brome	*Bromus inermis*
Russian wildrye	*Elymus junceus (Psathyrostachys juncea)*
Dryland orchardgrass	*Dactylis glomerata*
Western wheatgrass	*Agropyron smithii (Pascopyrum smithii)*
Thickspike wheatgrass	*Agropyron dasystachyrum (Elymus lanceolatus)*
Streambank wheatgrass	*Agropyron dasystachyrum riparium (Elymus lanceolatus riparium)*
Sheep fescue	*Festuca ovina*
Hard fescue	*Festuca ovina* var. *duriuscula*
Big bluegrass	*Poa ampla*
Indian ricegrass	*Oryzopsis hymenoides*
Cicer milkvetch	*Astragalus cicer*
Lewis flax	*Linum perenne lewisii*
Alfalfa	*Medicago sativa*

A.3.2 Weed Surveys

Weed surveys would be conducted weekly after initial seeding to monitor for the presence of noxious weeds. Weeds identified through the surveys would be chemically treated or mechanically or hand-removed before they develop seeds or have the opportunity to spread rhizomatious roots and establish large colonies that are hard to eradicate. Fall and spring weed surveys would be conducted to identify and locate perennial and biennial weeds in their early stages of development. Photographs or drawings of the noxious weeds described in Section A.2 would be distributed to the construction contractors to help identify weeds and take steps to eradicate them using approved methods.

A.3.2 Herbicide Control

Herbicides such as Roundup™, Weedmaster™, Banvel™ and similar products can be effective in control of noxious weeds. Herbicides should always be applied according to the manufacturers' printed recommendations and according to Federal regulations governing herbicide application.

All Federally Restricted-Use Herbicides must be applied by a Certified Applicator (U.S. Dept. of Agriculture 1993). Commercial and private applicators of Federal Restricted-Use Herbicides must keep a record of the Federal Restricted-Use Herbicide applications: The record must contain the following information:

- The brand or product name of the Federal restricted-use herbicide and its EPA registration number
- The total amount of the herbicide applied
- The size of the area treated
- The crop, commodity, stored product or site to which the herbicide was applied
- The location of the herbicide application
- The month, day and year of the application
- The certified applicator's name and certification

The information must be recorded within 30 days following the herbicide application. The record must be kept for two years from the date of the herbicide application.

A.3.4 Mechanical or Hand Control

Mechanical or hand control of noxious weeds identified in areas disturbed by construction activities would be used as an alternative to herbicide application. Mechanical control would involve using construction equipment such as a bulldozer or loader to scrape the soil surface and collect the weeds prior to development of seeds. Hand control of weeds would involve digging or pulling up weeds using hand tools prior to development of seeds. Collected weeds would be burned or properly disposed to prevent spreading onto other disturbed areas.

Appendix B

WCWEP, DRP and PRRP EISs Impact Analysis Methodology

Appendix B

WCWEP, DRP and PRRP EISs Impact Analysis Methodology

B.1 Introduction

This appendix describes the methodology used to analyze impacts on each resource presented in Chapter 3 of the Wasatch County Water Efficiency Project and Daniel Replacement Project (WCWEP and DRP) Environmental Impact Statement (EIS) and Chapter 3 of the Provo River Restoration Project (PRRP) EIS. The methodologies for the WCWEP and DRP EIS are presented first. The PRRP methodologies refer to the WCWEP and DRP methodologies where possible to avoid duplication.

B.2 WCWEP and DRP Analysis Methodologies

The methodologies are presented by resource in the order they appear in Chapter 3 of the WCWEP and DRP EIS.

B.2.1 Water Resources Analysis Methodology

The water resources analysis methodology includes assumptions and impact topic analysis methods for surface water and groundwater. A more detailed discussion of the water resources analysis methodology is presented in the Draft Water Resources Technical Report (CUWCD 1996c).

B.2.1.1 Assumptions

The surface water analysis relies on the PROSIM and MODFLOW models (described in Section B.2.1.2.1) to produce simulations of surface water conditions in Heber Valley. Computations with spreadsheets also are used to analyze water needs and supply availability. These models, spreadsheets and their input data require many assumptions. Major assumptions used in the surface water analysis are listed below for baseline conditions, the Proposed Action and the DRP alternatives.

B.2.1.1.1 Assumptions Used In Modeling Baseline. The following key assumptions were used to model surface water and groundwater baseline conditions:

- Minimum streamflow requirements of 125 cubic feet per second (cfs) are in place at all times in the Provo River between Jordanelle and Deer Creek reservoirs

- The Central Utah Water Conservancy District (CUWCD) allocates the same average annual amount of Central Utah Project (CUP) water as previously allocated by the USBR in the 1988 draft supplement to the Definite Plan Report (USBR 1988b). These average annual allocations are:

Agricultural, Francis area:	3,000 acre-feet
Agricultural, Heber City area:	12,100 acre-feet
M&I, Heber City area:	2,400 acre-feet
M&I, North Utah County:	20,000 acre-feet
M&I, Salt Lake County:	70,000 acre-feet
Total:	107,500 acre-feet

- All CUP municipal and industrial (M&I) water in the Heber City area is conveyed through the Wasatch Canal to a centralized water treatment plant near Heber City, and treated water would be distributed across the valley from the treatment plant.

- Future Heber Valley water consumption will remain essentially the same as present, although use will shift from agricultural to M&I. Lands converted from agricultural to other uses use about the same quantity of water as the existing lands. Water users will continue to rely on surface water as the primary source and not the valley's groundwater basin. All new rights for groundwater extraction to supply new development would be obtained through exchange and retirement of local surface water rights.

- Jordanelle Reservoir is fully operational and all CUP water users reach full buildout demand levels with full utilization of Provo River water supplies. The Provo River demands are:

  Provo River Project: ....100,000 acre-feet every year
  CUP: ....107,500 acre-feet variable annual demand
  Summit County Water Users: ....Historical diversions limited to water rights
  Wasatch County Water Users: ....Historical diversions limited to water rights
  Utah County Water Users: ....Historical diversions limited to water rights

- All diversions on the Provo River are made according to water right limits.

- Future transbasin diversions from the Strawberry River Basin to the Provo River Basin by Daniel Irrigation Company are the same as the quantities that historically occurred over the hydrologic period 1950-1989.

- Twelve percent of diverted, unconsumed agricultural water in Heber Valley is lost from the Provo River system and does not return to the river. Unconsumed agricultural water is water that is not transpired into the air by crops or evaporated.

- Potential water right adjudications by the Utah state engineer are speculative at this time and therefore are not considered.

- The Central Utah Project Completion Act (CUPCA) authorized CUWCD to purchase "from willing sellers or exchange, twenty-five thousand acre-feet of water rights in the Utah Lake drainage basin" to establish, among other things, "flows in the Provo River from the Olmsted Diversion to Utah Lake, a minimum of seventy-five cubic feet per second." CUWCD has not identified a water supply for meeting the 75 cfs instream flow requirement. Therefore, this instream flow requirement is not included in the PROSIM modeling conducted for this EIS (it applies to baseline, Proposed Action and DRP alternatives).

B.2.1.1.2 Assumptions Used In Modeling the Proposed Action and Alternatives. The following key assumptions that differ from assumptions used for baseline conditions were used to model the Proposed Action and alternatives:

- The same amounts of CUP water are allocated under the Proposed Action as under baseline conditions. Irrigation companies in Heber Valley conserve water through water efficiency improvements and make the conserved water available to the CUWCD for meeting the Daniel Replacement Project supply requirements. Under the DRP alternatives, uncontracted CUP agricultural water in Heber Valley is used to meet the Daniel Replacement Project supply need, and the amount of CUP water available for contracting is reduced by the amount of the Daniel Replacement Supply.

- Baseline flows needed in the lower Provo River to protect the June Sucker, an endangered fish, cannot be stored in Jordanelle Reservoir. Baseline spills in excess of the needs of downstream users or the June Sucker can be stored in Jordanelle Reservoir.

- The Daniel Replacement supply to DIC is delivered in a pattern that maximizes efficiency and minimizes construction costs and water shortages within the irrigation company's boundaries. Deliveries mainly occur from July through September rather than during the spring and early summer snowmelt months when transbasin water was historically available.

- Under the Proposed Action, the WCWEP is responsible for providing water to meet all water conveyance losses in the Timpanogos Canal associated with the DRP supply. Under the DRP With Canal Alternative, uncontracted CUP agricultural water would be used to offset the losses.

- Supplemental instream flow deliveries depend on the amount of water conserved in any given year.

- The Proposed Action and alternatives may not reduce or alter the timing of baseline water supply diversions to users downstream of Deer Creek Reservoir. Water stored in Jordanelle Reservoir is released as necessary to avoid a water supply impact to users downstream of Deer Creek Reservoir. In actual operation, the affects of the Proposed Action or alternatives on downstream water users would have to be estimated each year by the Provo River Commissioner. An agreement between the water users below Deer Creek Reservoir and CUWCD will be negotiated to address the mechanism for determining the effects of the Proposed Action on inflow quantities to Deer Creek Reservoir and the procedure to be followed by the River Commissioner in estimating releases from Jordanelle Reservoir to avoid downstream impacts on water supply.

- Water conserved under the Proposed Action is storable by CUWCD where space is available in Jordanelle and Deer Creek reservoirs, at the priority under which the diversion would have been made if it had not been conserved.

B.2.1.2 Impact Topic Analysis Methods

B.2.1.2.1 Overall Approach. Most of the potential surface water changes identified in this water resources analysis were modeled with PROSIM, which is a comprehensive surface water, Provo River Project and CUP operations model that simulates Provo River, Jordanelle Reservoir and Deer Creek Reservoir surface water conditions. PROSIM is a computerized representation of the hydrology, facilities, water rights and institutional arrangements of the Provo River system. PROSIM models all of the Provo River watershed, the Weber River above the mouth of Weber Canyon, Utah Lake, and the upper Duchesne River on a monthly time periods. It also models transbasin diversions from the Weber River, Strawberry Reservoir and Duchesne River to the Provo River basin. Potential surface water changes in Daniels Creek, the streams to receive supplemental flows, and the supplies of irrigation companies in Heber Valley were defined using a hydrologic spreadsheet model (which is separate from the PROSIM model).

Potential groundwater changes were modeled with MODFLOW, a general-purpose groundwater model. Development and calibration of the MODFLOW model of Heber Valley was performed by the U.S. Geological Survey (USGS) in cooperation with the Utah Department of Natural Resources (UDNR) and Wasatch County. The model divides Heber Valley into a network of 40-acre elements consisting of 45 rows by 45 columns.

The Heber Valley groundwater basin is represented by two aquifer layers with varying parameters, including water storage and flow rates for each 40-acre element. The model was run to represent the same hydrologic period that was used for PROSIM. MODFLOW, like PROSIM, is run with monthly time periods. The model calculates water levels, storage and return flows for each month of the modeled hydrology.

The water resources analysis consisted of the following five major steps:

- Comparing and reconciling the PROSIM and MODFLOW hydrology models
- Defining the modeling scenarios, assumptions and input data
- Conducting the PROSIM and MODFLOW model runs
- Documenting the PROSIM and MODFLOW output
- Preparing water resources impact summaries and water balance documentation

Impacts were evaluated over a 40-year study period using the hydrology that occurred from 1950 through 1989 with future demand levels. The results presented are for years 1 through 40 of the study period.

Baseline conditions that were modeled are future conditions that would likely occur under full water use development. Baseline conditions are significantly different from existing and historical conditions for several reasons. For example, the EIS baseline includes a fully operational Jordanelle Reservoir. This includes deliveries of 90,000 acre-feet a year of CUP M&I water to Utah and Salt Lake counties; 2,400 acre-feet a year of CUP M&I water to Wasatch County; 12,100 acre-feet a year of supplemental agricultural water to Heber Valley; and 3,000 acre-feet a year of supplemental agricultural water to the southern Kamas Valley. On-farm water application efficiencies were assumed to increase under baseline conditions from the current 18 to 35 percent to 40 percent as a result of improved water management and measuring techniques.

Several other river system operational changes are included in baseline conditions that have occurred only recently or are not yet in effect, including the Utah Lake Interim Water Distribution Plan (UDNR 1992). This is a plan by the Utah Division of Water Rights for managing the water supply of the Utah Lake drainage, especially during low flow years. Another change from existing conditions is the 125 cfs minimum instream flow requirement between Jordanelle and Deer Creek reservoirs. This requirement was among the commitments included in the Final Supplement to the Final Environmental Impact Statement on the CUP, M&I System (USBR 1987) that analyzed the effects of Jordanelle Reservoir. This EIS uses the commitments of the 1987 EIS in all modeling assumptions. The provisions of the recently negotiated Deer Creek/Jordanelle Operating Agreement also are included in the modeling of the baseline conditions. These provisions have not been reflected in historical or existing conditions.

B.2.1.2.2 Surface Water Methodology. Surface water conditions were modeled by PROSIM and a hydrologic spreadsheet model. Results were compared against baseline results to determine the impacts of the Proposed Action and alternatives.

The distribution of CUP agricultural water by month, year and irrigation company was in proportion to the irrigation supply shortages of each company. Consumptive use and water diversion requirements were defined by a Technical Advisory Committee (CUWCD 1993b). Supply shortages were calculated for each irrigation company on a monthly basis by subtracting the available water supply from the computed diversion requirement.

To avoid potential reductions in diversions and streamflow in the Provo River below Deer Creek Reservoir, CUP water stored in Jordanelle and Deer Creek reservoirs in the PROSIM model is released when necessary to supplement Lower Provo River flows. Thus, if modeled flows under one of the EIS alternatives are less than modeled flows under baseline conditions, water is released from Jordanelle storage to bring the flow up to the level under baseline conditions subject to certain limits specified in the Deer Creek Biological Opinion.

To avoid potential impacts on areas outside the Provo River basin, transbasin diversions from the Weber and Duchesne rivers were limited to the amounts diverted under baseline conditions.

B.2.1.2.3 Groundwater Methodology. The groundwater methodology considered four impact topics: groundwater recharge, discharge and storage; groundwater levels; groundwater levels in wetland areas; and wells and springs. The following subsections describe the methodology used for each topic.

B.2.1.2.3.1 Groundwater Recharge, Discharge and Storage. A spreadsheet model was used to calculate crop consumptive use and the amount of recharge to the groundwater basin for all Heber Valley irrigation companies on a monthly basis. The amount of applied water for each irrigation company, including CUP and non CUP water, was added to precipitation to determine total available water supply. During months when the total available water supply of an irrigation company exceeded crop needs, consumptive use was set equal to the full potential consumptive use. During months with less than a full water supply, consumptive use was set equal to the ratio of available supply to crop need, multiplied by the full potential consumptive use.

The computed consumptive use was subtracted from the total available water supply to determine the amount of water that would percolate into the ground as groundwater recharge. This recharge was input to the MODFLOW model and was "spread" in the model over the irrigation company land. Seepage from canals (conveyance losses) and streams also was computed in the spreadsheet model and input to MODFLOW. Groundwater recharge differences between alternatives and baseline conditions were determined and documented as change in unconsumed agricultural water and precipitation, supplemental instream and Daniels Creek channel seepage.

Groundwater discharge was computed within the model. Discharge to local drains and seeps, evapotranspiration, Snake Creek, Provo River, and Deer Creek Reservoir was summarized by the model for each month of simulation. Impacts under the alternatives were determined by computing the change in these discharge values between the baseline conditions and each alternative.

Monthly changes in groundwater storage were defined by determining the monthly difference between groundwater discharge and recharge. Monthly changes in recharge, discharge and storage were summarized in water budget tables.

B.2.1.2.3.2 Groundwater Levels. The model was used to simulate groundwater level changes for each month and for each 40-acre element in Heber Valley. These water levels were compared using contour maps of the entire basin for a representative time period and by using hydrographs that show seasonal and annual fluctuation in water levels for a representative location. Using these two graphic summary tools, the baseline model results were compared to each alternative to determine impacts on groundwater levels. Baseline groundwater levels and impacts associated with the Proposed Action and alternatives were documented in this report with contour maps, hydrographs and cross-sections.

B.2.1.2.3.3 Groundwater Levels in Wetland Areas. The MODFLOW model is a regional groundwater model that simulates general groundwater level changes, assuming uniform distribution and application of surface water in each irrigation company. A more detailed groundwater analysis was conducted in wetland areas to evaluate site-specific conditions. Specific areas of land in 5-acre parcels and their specific irrigation methods and recharge rates were evaluated. Areas that would be converted to sprinkler irrigation were mapped and overlaid on a map with wetlands. The focus of the detailed analysis was thus narrowed to the areas with wetlands. Site-specific changes in groundwater recharge from baseline conditions were computed for areas of concern that would be converted to sprinkler irrigation. No change in recharge was assumed for areas not converted. The change in recharge was multiplied by the average water content of the soil in the affected areas to define potential changes in shallow groundwater levels. The lateral area influenced by the change in groundwater level under the converted areas was determined and mapped.

B.2.1.2.3.4 Wells and Springs. Well and spring impacts were assessed by using the groundwater level results. The well impacts were analyzed by using the change in groundwater levels compared to usable depth of the wells. Potential impacts related to water wells were summarized by comparing groundwater analysis results with published information on existing wells. Water level changes could increase or decrease the lift necessary to raise water to the land surface, thus increasing or decreasing pumping costs. Water levels also could potentially interfere with pump level settings or drop below a producing water zone. In this case the pumps would have to be lowered or the well deepened.

Since individual springs were not specifically modeled, groundwater levels were reviewed to demonstrate potential impacts related to springs. A combination of modeling results and professional judgment was used. Potential impacts on springs were analyzed only for the main springs mapped by the USGS. Impacts on springs were analyzed by using the change in groundwater levels and the season in which those levels are expected to change in the vicinity of the springs.

B.2.1.2.4 Water Supply Availability Impact Methodology. The potential water supply availability impacts were assessed by comparing computed supply shortages under the Proposed Action and alternatives with baseline supply shortages. Using a spreadsheet model, the total available water supply, including CUP, non-CUP and DRP supplies was compared to the monthly diversion requirement for each of the irrigation companies in Heber Valley. Where two or more companies presently receive water from the same canal, the baseline water supply was divided among the irrigation companies, using the Morse Decree water right classes so shortages could be properly computed for each company. The overall supply shortage for the valley was computed by totaling the shortages of each irrigation company. The diversion requirements used in the spreadsheet consisted of net consumptive use and irrigation efficiencies that reflect the weighted average irrigation method and conveyance efficiencies which change under the alternatives. Fifty percent of the rainfall during the growing season was considered effective in computing net consumptive use (CUWCD 1993e).

B.2.2 Water Quality Analysis Methodology

This section presents the water quality analysis methodology. A more detailed discussion is presented in the Draft Water Quality Technical Report (CUWCD 1996e).

B.2.2.1 Assumptions

The water quality analysis assumes existing flood irrigation practices do not create surface runoff into streams and canals (U.S. Soil Conservation Service 1994) because the alluvial soils in Heber Valley are very porous. Conversion to sprinkler irrigation would therefore not change the pathway of return flows from irrigation back to the streams, canals or Deer Creek Reservoir. However, it would change the volume of water returned to Deer Creek Reservoir through groundwater return flow pathways because use of conserved water to augment stream flows would increase surface discharge to the reservoir at the expense of groundwater.

The water quality analysis assumes the impacts of existing nonpoint source pollution practices are reflected in the existing water quality monitoring data. Therefore, unless future activities (included under baseline conditions or associated with the Proposed Action and alternatives) create or expand nonpoint source activities, the impacts of these existing activities are already included in the monitored data.

The water quality analysis assumes the parameters are conservative and that water quality changes can be estimated with mixing and dilution. The parameters are considered conservative because it is assumed they would not change phases, for example, nitrates (NO_3) to nitrite.

Jordanelle Reservoir was constructed with a Selected Level Outlet Works (SLOW) to help protect downstream water quality by allowing water to be discharged from different layers in the reservoir based on water temperature. However, the operational memorandum for the SLOW is being prepared for the summer of 1996, and limited monitoring data available for the reservoir reflect conditions when the reservoir is not fully operational. Therefore, it was assumed the quality of water discharged from Jordanelle Reservoir for baseline conditions and the alternatives could be represented with reservoir surface water monitoring data collected by Jordanelle Technical Advisory Committee (JTAC) in 1993 (EWPE 1994). This assumption is supported by concentrations projected by Sowby and Berg (1984) after the data were corrected for phosphorus sedimentation. Sowby and Berg projected a reservoir total phosphorus (TP) concentration of 39 µg/l without sedimentation. They projected phosphorus sedimentation at about 50 percent per year or 4,800

Kg/yr. Correcting the projected concentration of 39 micrograms per liter (µg/l) for 50 percent sedimentation yields an in-reservoir TP concentration of 20 µg/l. This value closely matches the 1993 monitored surface water concentration of 21 µg/l TP (EWPE 1994).

Provo River monitoring data collected from 1984 through 1989 were assumed to represent conditions before operation of Jordanelle Reservoir.

It was assumed existing groundwater concentrations of TP and NO_3 have reached steady- state conditions with groundwater recharge. This assumption is reasonable because the primary source of groundwater is recharge, and the groundwater is shallow and of relatively recent origin. This means historical groundwater concentrations are not undergoing significant change and reflect the long-term quality of the recharge water. The TP and NO_3 concentrations in groundwater recharge equal existing groundwater concentrations under this assumption. Short-term climatic conditions were assumed to not affect existing groundwater concentrations, and existing concentrations were used to represent average-, wet- and dry-year conditions.

Baseline water quality conditions in London Ditch, Creamery Ditch, lower Lake Creek, Snake Creek, and Daniels Creek are assumed to be the same as existing conditions.

It was assumed existing temperature monitoring data collected before construction of Jordanelle Reservoir for the Provo River and Rock Ditch represented baseline conditions when instream flows at the time of sample collection were similar to baseline flows. This assumption is reasonable for dry-water-year, high-temperature conditions where temperature would be largely controlled by climatic conditions and solar heating at the stream surface. This assumption also is supported by results of the temperature transition zone modeling completed as part of this assessment, which showed that the temperature of Jordanelle Reservoir under these conditions would only affect a very small reach of the Provo River below the dam.

The average annual TP load from Main Creek outside the project area was assumed to equal the average 1988 through 1993 loads estimated by EWPE (1994) or 1,290 kilograms per year (kg/year). Deer Creek Reservoir TP retention coefficients were assumed to be 25 percent, 48 percent and 17 percent for average-, dry- and wet-year conditions, respectively, based on values calculated by EWPE (1994).

B.2.2.2 Impact Topic Analysis Methods

Existing water quality conditions were defined and adjusted to develop baseline conditions using results of the water resources analysis Section B.2.1. As described in that section, baseline conditions are significantly different than existing and historical conditions. Potential water quality impacts of each alternative were then defined by comparing baseline water quality conditions to conditions expected to occur under the Proposed Action and alternatives.

The general approach used to estimate baseline conditions consisted of utilizing existing surface water and groundwater quality data to determine quality characteristics for water originating in Heber Valley and water flowing into the valley from the Provo River. The water quality characteristics of Heber Valley source water were assumed to reflect the nonpoint source pollution activities in the valley. Baseline conditions were then estimated by adjusting the water flowing into the valley from the Provo River, using estimated water quality conditions with a fully operational Jordanelle Reservoir, and adjusting the characteristics using pollutant loads contributed by Heber Valley water. The same approach was used for analyzing the Proposed Action and alternatives, which allows groundwater and surface water pollutant loads to be adjusted for changes in the use of water discharged from Jordanelle Reservoir and from changes in nonpoint source activities in the valley.

Baseline water quality of the discharge from Jordanelle Reservoir was determined using monitored data from the Reservoir and previous studies. Sowby and Berg (1984) estimate Jordanelle Reservoir would retain about 50 percent of the existing annual phosphorus inflow to Heber Valley from the Provo River, or 4,800 kg of phosphorus per year. Higher retention coefficients would be expected for sediment. Retention of phosphorus and sediment in Jordanelle Reservoir would reduce these constituent loads in downstream streams and canals and the loads to Deer Creek Reservoir. These expected load reductions were considered in establishing baseline conditions.

Baseline eutrophication conditions in Deer Creek Reservoir were evaluated using total phosphorus loads and a reservoir phosphorus sedimentation model. Phosphorus loads discharged into the reservoir were calculated for groundwater, Daniels Creek and the Provo River. Loads from Main Creek and phosphorus retention coefficients were obtained from estimates by EWPE (1994).

Hydrologic conditions predicted by the PROSIM and MODFLOW models were used to establish baseline water quality conditions and to analyze the alternatives. Model descriptions are presented in Section 2.4 of the Draft Water Resources Technical Report (CUWCD 1996c). These results were used to estimate pollutant loads and flow-weighted mean concentrations of TP, total suspended solids (TSS), and NO_3 for stream sites in Heber Valley, and to estimate phosphorus loads discharged to Deer Creek Reservoir. Annual pollutant loads and flow-weighted concentrations were estimated for average-, wet- and dry-year conditions.

Temperature changes in the Provo River and tributary streams receiving target supplemental instream flows were evaluated using a simplified heat balance. Temperature changes in the river due to side channels was evaluated using mixing and dilution calculations for a typical reach with the maximum side channel flow at 10 cfs and maximum side channel temperature of 70.6°F. Temperature changes in Upper Daniels Creek were evaluated using a qualitative comparison of the direct solar radiation on the creek compared with the direct solar radiation on water diverted from the upper Strawberry River basin.

The water quality analysis contains some uncertainties because of variations in existing monitoring data, the uncertainty of predicting future conditions after Jordanelle Reservoir is fully operational, and uncertainties in data from other related disciplines used in this analysis (i.e., Water Resources, Soils and Agriculture). Therefore, throughout the water quality analysis, conservative methodologies were used to help address uncertainties and to take a conservative approach in identifying adverse impacts.

B.2.3 Wetlands Analysis Methodology

This section describes the wetlands analysis methodology. A more detailed discussion is presented in the Draft Wetlands Technical Report (CUWCD 1996d).

B.2.3.1 Assumptions

Jordanelle Reservoir was not fully operational when the wetland impact analysis was conducted. The primary distinction between existing conditions and the future hydrology baseline conditions under Jordanelle related to wetlands is the availability and application of supplemental CUP water once Jordanelle Reservoir is fully operational, resulting in changes in existing groundwater levels. The future conditions of wetlands under the operation of Jordanelle Reservoir and the application of supplemental CUP water could not be determined, therefore it was assumed that existing conditions are baseline conditions for the wetland impact analysis.

B.2.3.2 Impact Topic Analysis Methods

Existing wetland resources were identified and mapped for over 17,000 acre in Heber Valley. Wetland boundaries were identified and plotted on September 1987, using color infrared aerial photography, and then transferred to a computer-generated line drawing (see Map A-3 in pocket at back of EIS). Field inspections were conducted during the summer of 1993 to verify the wetland maps and collect more information on vegetation, soils and hydrology. Wetlands were classified by vegetative community types and hydrology characteristics. These maps have not been modified to reflect future water use and diversions included in hydrology baseline conditions for the following reasons:

- Changes that could occur in the wetland hydrology are too speculative, and there is no accurate method to predict potential changes for existing mapped, site-specific wetlands
- U.S. Army Corps of Engineers (COE) review of the wetlands impact assessment and future wetlands permitting for the Proposed Action and alternatives would be based on potential impacts on existing wetlands, not on hypothetical wetland conditions in the future

Potential construction-related impacts were evaluated for each alternative by superimposing the engineering plans for each alternative on wetland maps. The resulting overlay was used to identify any specific wetland types that would be directly impacted by removal of vegetation and soil disturbance associated with canal modifications, pipeline alignments, pumping stations, construction roads and other construction activities. These areas were reviewed and measured in the field to develop an estimate of wetland impact area.

The analysis assesses potential indirect impacts on wetlands from operation of the Proposed Action and alternatives that would change groundwater or surface water flows into a wetland. The magnitude of any change was evaluated to determine whether it would potentially impact wetlands in the impact area of influence. Results of the PROSIM and MODFLOW models used to develop baseline conditions and assess potential impacts of the project were evaluated for groundwater elevation changes that would result from conversion from flood to sprinkler irrigation- (see WCWEP and DRP EIS Section 3.2, Water Resources). The groundwater contour map developed from MODFLOW model results shows the change between baseline conditions and alternatives, and was electronically superimposed over the wetlands map to determine areas that potentially would be impacted by increased or decreased groundwater levels. Wetlands covering areas where a 2- foot or greater groundwater elevation drawdown would occur were considered potentially impacted by the WCWEP. The 2-foot drop was used as the threshold because if the water table drops 18-inches or more below the ground surface, wetland hydrology criteria is not met. The MODFLOW model and available data on existing conditions could not provide an accurate prediction of change in an increment less than 2 feet, so the 2-foot criteria was used as the best information available for the analysis. The area of the mapped wetland types was measured by computer from the existing wetlands map. These areas were adjusted to reflect the amount of actual wetlands present in each mapping unit.

On April 2, 1996 a field investigation was conducted to review wetland areas that potentially would be impacted by the lowered groundwater elevations. The timing of the field work was scheduled to coincide with the end of spring runoff and prior to the beginning of the irrigation season, making it easier to determine the water sources supporting these wetlands. Hydrology, soils and vegetation were reviewed at each wetland site to determine if the wetland is supported by a water source that could be affected by the drawdown. Mapping was developed showing the wetland areas, identifying water sources and identifying those that would be impacted.

Indirect impacts on riparian wetlands in Heber Valley streams that would receive supplemental instream flows were evaluated by estimating the change in streamflow and the resulting impact on wetlands. Indirect impacts on riparian wetlands in upper Daniels Creek were evaluated by estimating the change in streamflow from eliminating the transbasin water diversion.

Results of the PROSIM and MODFLOW models were used to analyze potential indirect impacts on wetlands from changes in the amount of groundwater or surface water seeping from canals into wetlands. The magnitude of any change was evaluated to determine whether it would potentially impact wetlands in the area of influence.

B.2.4 Aquatic Resources Analysis Methodology

This section describes the aquatic resources analysis methodology. A more detailed discussion is presented in the Draft Aquatic Resources Technical Report (CUWCD 1996a).

B.2.4.1 Assumptions

The aquatic resources analysis assumed that the instream flows recommended by the Instream Flow Work Group of the Fisheries Technical Advisory Committee represent optimal flow levels. The analysis also assumed that existing conditions determined through field surveys represent baseline conditions in all streams except the Provo River. Provo River baseline conditions include a 125 cfs minimum instream flow and other factors affecting Provo River flows that are different from existing conditions.

The results of the Binns HQI Model II for predicted trout standing crop and the resulting calculation of predicted trout biomass assumed that the increases were due to natural production and not from stocking hatchery-produced fish.

The analysis of potential impacts also assumed that the results of the Binns Habitat Quality Index Model II that show changes in aquatic habitat features were generally applicable to non-game fish and other aquatic resources.

B.2.4.2 Impact Topic Analysis Methods

B.2.4.2.1 Game Fish and Their Habitat. Potential impacts on game fish and their habitat were analyzed by using the results of quantitative aquatic habitat field surveys to predict the magnitude of change in trout production resulting from implementation of the Proposed Action and alternatives. The Binns Habitat Quality Index (HQI) Model II was used to estimate potential changes in aquatic habitat (see description in Section B.2.4.2.1.2). The following subsections describe the field survey methodology used to define baseline conditions and the general procedures of the Binns HQI Model II.

B.2.4.2.1.1 Definition of Baseline Conditions. Baseline conditions were defined in the impact area of influence through field surveys that resulted in fish population estimates and other quantitative estimates of aquatic habitat. Conditions under the Proposed Action and alternatives were compared to baseline conditions to determine potential impacts.

Quantitative fish surveys were conducted along stream reaches in Heber Valley, Daniels Creek Canyon and the upper Strawberry River basin by Woodward-Clyde Consultants July 12 to 24, 1993. Fish population estimates, habitat quality ratings and basic water quality measurements were collected.

Stream survey data collected by the Utah Division of Wildlife Resources in the upper Strawberry River basin between 1984 and 1986 was used to describe baseline conditions in the upper Strawberry River, Willow Creek, Clyde Creek and Co-op Creek. These data included length and weight information for game and non-game fish species, and stream habitat quality ratings. The existing conditions reported by Utah Division of Wildlife Resources for streams in the upper Strawberry River basin represent conditions before treatment of the upper Strawberry Reservoir with rotenone in 1990. It is thought that the majority of game and non-game fish species in the reservoir and its tributaries were eliminated by this treatment. Recent efforts have been made to reintroduce certain non-game fish (e.g., speckled dace and mottled sculpin) to these tributaries.

Potential impacts to game fish and their habitat in the impact area of influence from construction-related activities of the WCWEP and DRP Proposed Action and alternatives were evaluated. Construction activities required for the Proposed Action and alternatives were reviewed to determine if any activities would cause temperature changes or indirectly affect game fish habitat through increased sedimentation and erosion or increased nutrient concentrations.

B.2.4.2.1.2 Binns Habitat Quality Index Model II. The Binns HQI Model II was developed as a tool for assessing instream flow needs of trout streams in the Intermountain West. The method involves the collection of standardized stream habitat information (nine habitat quality attributes), rating the attributes from 0 to 4 according to the methodology described in Binns (1982). The data is then scored as the Habitat

Quality Index, which represents the potential trout standing crop of a stream in pounds of trout per acre and the stream's carrying capacity if all habitat attributes equal or reach the assigned habitat attribute ratings.

Habitat quality information collected by Woodward-Clyde Consultants in the Heber Valley and Daniels Creek were used in the Binns HQI Model II to predict potential impacts of the Proposed Action and alternatives on game fish and their habitat. The following habitat quality attributes were measured or qualitatively estimated. Their designation for use in the Binns Model II calculations is denoted by X_1 through X_{11}:

- Late streamflow (X_1, typically estimated from on-site observations)
- Annual stream flow variation (X_2, typically estimated from on-site observations)
- Maximum summer stream temperature (X_3, measured during August)
- Nitrate-nitrogen (X_4, samples collected during July fish population surveys)
- Fish cover (X_7, includes overhanging vegetation, instream structure)
- Eroding stream banks (X_8)
- Submerged aquatic vegetation (X_9, used to estimate aquatic macroinvertebrate abundance)
- Current velocity (X_{10}, measured using dye)
- Wetted channel width (X_{11}, average of 11 measurements)

The HQI score (Y) was calculated using the Model II algorithm as shown below:

$$\text{Log}(Y+1) = -0.903 + 0.807\text{Log}(X_1+1) + 0.877\text{Log}(X_2+1) + 1.233\text{Log}(X_3+1) + 0.631\text{Log}(F+1) + 0.182\text{Log}(S+1)$$

where $F = (X_3)(X_4)(X_9)(X_{10})$; $S = (X_7)(X_8)(X_{11})$

An example of the calculations involved in the Binns HQI Model II is shown in Table B-1 for Spring Creek, Reach SP-01, baseline conditions.

Table B-1
Example Calculation of the Habitat Quality Index Score*

Habitat Attribute	Baseline Rating (0 to 4)
X_1	2
X_2	2
X_3	3
X_4	3
X_7	0
X_8	4
X_9	2
X_{10}	4
X_{11}	3

*Calculation:

$$\text{Log}(Y+1) = -0.903 + 0.807\text{Log}(2+1) + 0.877\text{Log}(2+1) + 1.233\text{Log}(3+1) + 0.631\text{Log}((3*3*2*4*)+1) + 0.182\text{Log}((0*4*3)+1)$$

$= 1.1819Y$

$= 65$ pounds/acre (predicted trout standing crop)

For this EIS, the Binns Model was used as a predictive tool to estimate potential changes in trout standing crop, given changes in one or more habitat attributes under the Proposed Action and alternatives. For example, providing supplemental instream flows under the Proposed Action would be expected to improve several habitat attributes, such as late summer flows, maximum summer stream temperature and submerged aquatic vegetation. Expected improvements in these attributes would lead to higher ratings for these attributes in the Binns Model and a predicted increase in fish standing crop.

For the upper Strawberry River basin, the predicted trout standing crop estimates reported by Utah Division of Wildlife Resources are included in this analysis as representative of the potential trout standing crop that would be expected under baseline conditions. Potential impacts in the upper Strawberry River basin from elimination of the transbasin diversion and restoration of natural flows are based on analyses conducted by the U.S. Forest Service (USFS).

B.2.4.2.2 Non-Game Fish and Their Habitat. Potential impacts on non-game fish and their habitat were analyzed in a similar manner to that described for game fish in Section B.2.4.2.1. The Binns HQI Model II is specific to game fish species (i.e., trout). Interpretation of the results (i.e., changes in certain habitat attribute ratings) for potential effects on non-game fish was done using information on non-game fish species habitat requirements and best professional judgment. The Binns Model results under the Proposed Action and alternatives were compared to baseline conditions. Any changes from baseline conditions were compared to habitat preferences or life history requirements of non-game fish to determine if potential changes in habitat quality would be beneficial or adverse to non-game fish.

B.2.4.2.3 Other Aquatic Resources. Potential impacts on other aquatic resources (i.e., amphibians and macroinvertebrates) were analyzed using methods described in Section B.2.4.2.2 for non-game fish and their habitat. Best professional judgment was used to evaluate potential impacts from changes in habitat attributes and habitat quality.

B.2.5 Wildlife Resources Analysis Methodology

B.2.5.1 Assumptions

The impact analysis for wildlife resources assumed that existing wildlife resources and their habitat will be present when the WCWEP and DRP is implemented. The assumptions defined in Section B.2.3.1 for wetlands are incorporated into the wildlife resources analysis because the wetlands analysis included potential impacts on vegetation types that comprise available wildlife habitat in the impact area of influence.

B.2.5.2 Impact Topic Analysis Methods

The overall approach of the analysis was to identify probable wildlife species in the impact area of influence and probable habitat use through existing information. The following were used to describe habitat use:

- The mapping units described in the wetlands analysis (see Section 3.4.6 of the WCWEP and DRP EIS)
- Non-wetland riparian vegetation and upland woodland habitat

Impacts on game and non-game species and their habitats were analyzed for the Proposed Action and alternatives based on results of the wetlands impact analysis, which quantified impacts on existing vegetative types, and an analysis of construction and operations impacts on riparian vegetation and upland woodlands.

Wildlife habitat utilization was categorized based on grouping the wetland and non-wetland vegetation into habitat categories of principal importance to most of the species identified. The three habitat categories include:

- Non-riparian wetlands comprised of wet meadow, moist meadow and emergent marsh
- Riparian woodlands comprised primarily of cottonwood, willow and hawthorn trees and associated shrubs
- Upland woodlands comprised primarily of Gambel oak, juniper, sagebrush, serviceberry and upland grasses

B.2.6 Threatened and Endangered Species Analysis Methodology

This section presents the threatened and endangered species resources analysis methodology. A more detailed discussion is presented in the Draft Threatened and Endangered Species Technical Report (CUWCD 1996b).

B.2.6.1 Assumptions

The analysis assumed that lack of documented sightings of a particular species does not necessarily mean it is absent from the impact area of influence. Even under optimal survey conditions, a species may be missed, especially if identification relies on certain characteristics (i.e., flowering parts on a plant that does not reproduce every year). For this reason, species presence was assumed if suitable habitat is available and if the species has a high potential to occur in the impact area of influence or was identified during surveys.

For most threatened and endangered (T&E) species, baseline conditions were assumed to be equal to existing conditions. However for June sucker, baseline conditions in the lower Provo River equaled conditions under full operation of the Jordanelle Reservoir.

B.2.6.2 Impact Topic Analysis Methods

The impact topics for T&E species were identified from Section 7 of the Endangered Species Act (ESA). Changes in T&E species under these impact topics between baseline conditions and the Proposed Action and DRP alternatives were analyzed. Best professional judgment was used to determine if there would be impacts on T&E species from the Proposed Action and DRP alternatives.

B.2.6.2.1 Peregrine Falcon. The following impact topics were used to determine effects on peregrine falcons.

B.2.6.2.1.1 Taking of a Species. Take, as defined in the ESA, means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Although loss of habitat is also considered taking of a species under certain circumstances, it is described as a separate evaluation criteria for this analysis. The assessment was based on the potential for an action in an occupied area to take the individual(s) regardless of efforts to avoid the take.

B.2.6.2.1.2 Loss of Degradation of Habitat. Habitat for T&E species was identified using criteria established in current literature and maps of wetland communities in Heber Valley. The engineering layout of the action alternatives was examined to determine if areas containing habitat would be altered or removed by construction, operation or maintenance. The analysis of habitat for T&E species relied heavily on results of the wetland analysis presented in Section 3.4 of the WCWEP and DRP EIS.

B.2.6.2.1.3 Increased Stress, Displacement, or Reduced Reproductive Success. The Proposed Action and DRP alternatives were examined to determine if construction, operation or maintenance would indirectly affect T&E species or their habitat. These activities could create increased levels of stress, displacement or reduced reproductive success if located near habitat, especially during sensitive periods such as breeding.

B.2.6.2.2 June Sucker. The impact analysis methods for June sucker were the same as described in Section B.2.6.2.1 for peregrine falcon. In addition, the PROSIM results (lower Provo River data points) presented in the Draft Water Resource Technical Report (CUWCD 1996c) were used to determine effects on June suckers. The analysis was based on estimated changes in flow during spawning.

B.2.6.2.3 Bald Eagle. The impact analysis methods for bald eagle were the same as described in Section B.2.6.2.1 for peregrine falcon.

3.7.2.2.4 Ute Ladies'-tresses. The impact analysis methods for Ute ladies'-tresses were the same as described in Section B.2.6.2.1 for peregrine falcon. In addition, a two-year (1993 and 1994) survey was completed for Ute ladies'-tresses to determine species presence in the impact area of influence.

B.2.6.2.5 Spotted Frog. The impact analysis methods for spotted frog were the same as described in Section B.2.6.2.1 for peregrine falcon. The methods also included a survey in 1993 for spotted frog in areas of direct impact; a review of recorded sightings from FWS and Utah Division of Wildlife Resources records and publications; and an on-site evaluation of wetland habitats for suitability.

B.2.6.2.6 Other Threatened, Endangered or Candidate Species. The impact analysis methods for all other T&E species were the same as described in Section B.2.6.2.1 for peregrine falcon.

B.2.7 Soil Resources Analysis Methodology

B.2.7.1 Assumptions

Baseline soil conditions are assumed consistent with the characteristics described in the published Soil Survey for the Heber Valley. The soil analysis also assumed flood irrigation in Heber Valley does not cause agricultural runoff and erosion to streams SCS 1994).

B.2.7.2 Impact Topic Analysis Methods

B.2.7.2.1 Soil Erosion and Stability. Maps A-1 and A-2 (see pocket at back of EIS) and the engineering layouts for the Proposed Action and DRP alternatives were reviewed to identify the location of potential canal modifications, pipeline alignments, pumping stations, streamflow enhancements and areas that would be converted from flood to sprinkler irrigation. These activities were analyzed using best professional judgment to determine changes between baseline conditions and the Proposed Action and DRP alternatives and identify potential impacts on soil erosion and stability.

B.2.7.2.2 Soil Quality. Data from the NRCS were reviewed to describe physical and chemical soil quality characteristics under baseline conditions. Potential changes in the physical composition of the soil from construction activities were assessed by considering such factors as soil stratification, texture and topsoil characteristics. Potential changes in soil chemistry from changes in irrigation practices were assessed by considering such factors as leaching rates and salinity. Changes in soil quality between baseline conditions and the Proposed Action and DRP alternatives were analyzed to determine potential impacts.

B.2.8 Mineral and Energy Resources Analysis Methodology

B.2.8.1 Assumptions

Energy use during construction is assumed to include energy used by construction equipment, trucks hauling borrow material and pipes, and vehicles driven by commuting workers. It is assumed that construction equipment would use gasoline at typical rates.

Energy use during operation and maintenance (O&M) of the Proposed Action and alternatives is assumed to include electricity for pump stations and gasoline for commuting vehicles. Commuting vehicles are assumed to use gasoline at typical rates. Electricity use is assumed as horse power converted to kilowatts, multiplied by the equivalent number of hours the pumps would be operating full time. Electricity is assumed to be provided to pumping stations under the Proposed Action or DRP alternatives by wheeling Colorado River Storage Project (CRSP) power through local power lines operated by Heber Light and Power (HL&P).

B.2.8.2 Impact Topic Analysis Methods

B.2.8.2.1 Mineral Resources. Mineral resource sites in Heber Valley were identified and the amount, type and location of borrow material that would be used under the Proposed Action and DRP alternatives was determined. The ability of the identified mineral resource site to supply the necessary material was then determined by contacting a local gravel company that could be affected. Construction procedures and results of the transportation analysis were reviewed to determine if the Proposed Action and DRP alternatives would interfere with or otherwise affect the extraction of minerals from Heber Valley mineral resource sites compared to baseline conditions.

B.2.8.2.2 Energy Use During Project Construction Activities. Typical energy use factors were applied to the construction vehicle and transportation requirements as defined in Chapter 1 of the WCWEP and DRP EIS to estimate the energy that would be used by construction procedures, construction traffic and O&M traffic. A qualitative assessment of the energy that would be used by recreationists was conducted. Changes in energy use between baseline conditions and the Proposed Action and DRP alternatives were determined.

B.2.8.2.3 Energy Generation and Transmission Sources. The energy generation sources and transmission facilities that would be used by the Proposed Action and DRP alternatives were defined under baseline conditions. The availability of generation and transmission capacity at these sources and facilities was determined by contacting the affected energy utility. Changes in energy generation and transmission sources between baseline conditions and the Proposed Action and DRP alternatives were analyzed.

B.2.9 Air Quality Analysis Methodology

B.2.9.1 Assumptions

The typical emission factors defined by the U.S. Environmental Protection Agency (EPA) and used in this analysis (EPA 1985) are assumed to represent emissions during construction of the Proposed Action and alternatives. The Heber Valley is an air quality attainment area under baseline conditions. A worst-case approach was used by assuming construction vehicles and equipment would be used 8 hours a day and five days a week during construction, not including vehicles used by workers to commute to construction sites. The assumptions used in the transportation analysis (see Section B.2.17) also apply to the air quality analysis because the traffic estimates from the transportation analysis were used in this analysis.

B.2.9.2 Impact Topic Analysis Methods

B.2.9.2.1 Vehicle Emissions During Construction. Heber Valley's status as an attainment area was confirmed and applicable air quality standards were defined by contacting the staff of the Utah Air Quality Board. Baseline conditions were described qualitatively because air quality data for Heber Valley do not exist. Information concerning construction procedures, schedules, vehicles and equipment, and worker traffic was provided by the project engineering team and the transportation analysis. Typical EPA emission factors were defined and applied to determine the maximum emissions that would occur during construction over a one-year period. The projected air quality impacts of the project were reviewed to determine if the maximum allowable increase limits for attainment areas would be exceeded (see Section 3.10.2.2 of the WCWEP and DRP EIS for additional information regarding related air quality regulations).

B.2.9.2.2 Emissions From Recreation Traffic. Results of the recreation and transportation analyses were used to assess potential air quality impacts related to the recreation impacts of the Proposed Action and DRP alternatives. This would be an indirect impact of the Proposed Action and DRP alternatives and was assessed qualitatively. Unlike construction-related air quality impacts, these would not be subject to air quality regulations.

B.2.9.2.3 Dust Emitted From Construction Procedures. The proposed construction procedures and related standard operating procedures (SOPs) were reviewed to assess the potential for dust impacts during construction.

B.2.9.2.4 Dust Emitted From Changes in Agricultural Practices. Results of the agriculture analysis were used to determine if the Proposed Action and alternatives would cause changes in agricultural practices that could lead to air quality impacts.

B.2.10 Agriculture Analysis Methodology

B.2.10.1 Assumptions

Supplemental irrigation water from Jordanelle Reservoir and the CUP is assumed to be available in Heber Valley under baseline conditions. This would improve the reliability of existing water supplies and lead to changes in cropping patterns without implementation of the Proposed Action or DRP alternatives. Thus, the cropping pattern under the Proposed Action and DRP alternatives would not change because water supply reliability would be the major factor driving cropping pattern changes and this improved reliability would be essentially the same under baseline conditions, the Proposed Action and alternatives. The Heber Valley average and regional irrigation efficiency data, as reported in the Preliminary Planning Report (CUWCD 1993), are assumed to represent average irrigation efficiencies under baseline conditions, the Proposed Action and DRP alternatives. Crop yields are assumed to be affected by method of irrigation, water availability and water supply under dry, wet and average hydrologic conditions as reported in the water resources analysis (see Section 3.2 of the WCWEP and DRP EIS). Temporary impacts on grazing lands and croplands are assumed to cause a 1-year loss of production or use. Permanent impacts from construction are assumed to result in the permanent loss of agriculture on the affected lands.

B.2.10.2 Impact Topic Analysis Methods

B.2.10.2.1 Livestock Grazing and Production. Baseline livestock grazing capacity was estimated for potentially affected irrigation companies based on data contained in the U.S. Soil Conservation Service (SCS) Preliminary Investigation Reports. Livestock grazing capacity and production under the Proposed Action and DRP alternatives was estimated for each irrigation company in the impact area of influence based on anticipated crop yields reported in the SCS reports. The location of facilities under the Proposed Action and DRP alternatives was used to identify areas where construction activities and new facilities could result in temporary impacts on livestock grazing patterns, access to water, or other agricultural practices related to livestock grazing.

B.2.10.2.2 Livestock Watering and Production. Baseline grazing levels and patterns were provided for Daniels Canyon by the USFS. The amount of available Daniels Creek water under baseline conditions, the Proposed Action and DRP alternatives was obtained from the water resources analysis (see Section 3.2 of the WCWEP and DRP EIS). These data were used to estimate the potential effects of the Proposed Action and alternatives on grazing capacity and grazing patterns related to water availability.

B.2.10.2.3 Cropland and Crop Production. The existing cropping pattern in the impact area of influence was characterized by using land use data in the UDNR Land Use Inventory Report. The existing cropping pattern was modified based on SCS Preliminary Investigation Reports and Preliminary Planning Report (CUWCD 1993) to develop the expected crop acreage and type, crop yield and grazing capacity, and acreage irrigated by gravity and sprinkler irrigation systems under baseline, the Proposed Action and DRP alternatives. Estimated crop yields for the impact area of influence were developed based on the SCS Preliminary Investigation Reports (SCS 1993a, 1993b, 1993c, 1993d, 1993e, 1994, 1994a, 1994b, and 1994c) for both gravity and sprinkler irrigation assuming a full water supply. These crop yields were then adjusted to reflect expected water shortage conditions under baseline, the Proposed Action and DRP alternatives. The adjustments for alfalfa and pasture assumed a direct relationship between yield and water supply, i.e. if the water supply is 75 percent, then the yield would be 75 percent of that expected with a full water supply. For barley, which is planted in the spring and harvested early in summer, it was assumed the minimum yield would be 50 bushels per acre. Barley yields were adjusted in 5 bushel-per-acre increments to a maximum yield of 100 bushels per acre based on a direct relationship between yield and the amount of water available. For example, if the water supply for a 50 bushel-per-acre yield was 20 acre-inches and a 100 bushel-per-acre yield was 30 acre-inches, with an actual water supply of 25 acre-inches the barley yield would be adjusted to 75 bushels per acre.

B.2.10.2.4 Agricultural Practices and Operations. The preliminary engineering layout for the Proposed Action and DRP alternatives, and the area where conversion to sprinkler irrigation would be made possible by the WCWEP and DRP, was reviewed and used to identify potentially affected croplands and related practices and operations. Potential changes to such agricultural practices and operations as fertilizer and pesticide applications, alterations to facilities and disruptions to grazing patterns were considered. Data from the soils discipline were used to assess potential impacts on cropland related to soil quality and construction activities.

B.2.10.2.5 Prime Farmlands. Prime farmlands are those that have the best combination of physical and chemical characteristics for the production of agricultural crops (see Glossary for definition of "Prime Farmlands"). Data from the SCS (SCS 1976) were reviewed to determine if prime farmlands are present in the impact area of influence.

B.2.11 Socioeconomics Analysis Methodology

B.2.11.1 Assumptions

This analysis assumed socioeconomic trends already in evidence in Heber Valley will be present under baseline conditions. It is assumed the year 2000 is representative of baseline conditions when potential impacts of the Proposed Action and alternatives are expected to begin. Socioeconomic impacts only were quantified in the impact area of influence. Potential socioeconomic impacts outside the area of influence were assumed to be too widespread and diffuse to measure.

Baseline population, income and employment estimates were developed assuming a "high growth" scenario (Utah Office of Planning and Budget 1992) This is a reasonable assumption given the significant growth in population in Heber Valley over the past few years. The effects of the 2002 Winter Olympics in nearby Summit County are not reflected in the growth scenario developed by the Utah Governor's Office of Planning and Budget. However, the economic activity currently projected as a result of the 2002 Winter Olympics supports the use of "high growth" projections for this analysis.

The assumed prices for barley straw ($35 a ton) and animal grazing units ($10 per AUM) were estimated using Wasatch County budgets from Utah State University (G.D. Miller and E.B. Godfrey 1993) and information provided by Wasatch County Cooperative Extension Service (Wasatch County 1994) and NRCS staff (NRCS 1995). The assumed prices for alfalfa hay ($68.17 a ton), barley ($2.24 a bushel) and oat hay ($54 a ton) were estimated based on data from the Utah Agricultural Statistics Service (1995).

Supplemental irrigation water is assumed to be available from Jordanelle Reservoir and the CUP under baseline conditions, which is expected to improve the reliability of existing water supplies and cause cropping pattern changes for some agricultural operations. These changes are expected to cause agricultural economic impacts (an increase in agricultural income and employment) before construction of the Proposed Action and alternatives.

Under the Proposed Action, it was assumed that irrigation company water assessments would remain the same for the Center Creek, Daniel and Lake Creek irrigation companies for delivery of non-CUP water. The cost of non-CUP water to other irrigation companies participating in the WCWEP would change from a total of $8 per acre under baseline to $1.50 per acre, plus $5 per acre-foot of water used — an increase in the overall costs to the irrigator. The cost of supplemental CUP water would be $12 per acre-foot to all companies.

Seventy-five percent of the construction workers are assumed to commute from the Salt Lake City and Provo/Orem areas, and the remainder from their residences in local Wasatch County communities. Therefore, local workers are not expected to increase the demand for permanent or temporary residential housing. It is assumed for this analysis that 50 percent of the gasoline required by construction workers and 100 percent of the gasoline required by construction vehicles would be purchased locally.

It is assumed the Proposed Action and alternatives would be operated and maintained by the Wasatch County Special Service Area (WCSSA). Funding for all necessary O&M activities would be included in the WCSSA budget.

Recreationists attracted to the restored streams of the upper Strawberry River basin are assumed to travel from the Salt Lake City, Provo and Orem areas and through Heber Valley. They are assumed to stay in Uinta National Forest campgrounds and to spend money in Heber Valley during these trips. An expense multiplier of $18.40 per angler day was used to estimate the average expenses for anglers visiting Heber Valley. The analysis assumed that multi-day visits would involve camping only and that the bulk of recreationists would travel into Wasatch County from the Wasatch Front. The multiplier is comprised of three categories of expenditures: gasoline, other transportation costs, and food and beverages (Bear West 1993). This factor was used to estimate the impact of recreationists on the retail trade sector and regional Wasatch County income.

It was assumed changes in gross revenue also would affect income by place of work. Based on historical ratios between gross retail sales and income by place of work, it was assumed about 20 percent of gross revenue changes would be a change in gross income. Gross revenue also is expected to impact local and state sales tax revenue. For this analysis, the local and state sales tax rates are both assumed to be 3 percent of gross retail sales or revenue.

Changes in the revenue of retail trade businesses after construction were assumed to cause an increase in employment equal to one full-time employee for every $20,000 increase in revenue.

Construction of the Proposed Action would require pipelines to be installed in roads adjacent to businesses. It is assumed for this analysis that 10 percent of Wasatch County businesses would be affected by a 40 percent reduction in business for four weeks.

B.2.11.2 Impact Topic Analysis Methods

B.2.11.2.1 Population. Baseline population conditions were defined and potential population impacts were assessed by considering the potential for permanent residents to be attracted by new and permanent employment opportunities or other growth-inducing factors.

B.2.11.2.2 Agricultural Economics. Typical farm budgets were prepared to assess the agricultural economic impacts related to the results of the Agricultural Resources analysis in Section 3.11 of the WCWEP and DRP EIS. Table B-2 includes the types of parameters used in the analysis of typical farm budgets. Potential impacts of the Proposed Action and alternatives on farm gross revenue and production costs also were defined. A crop enterprise approach was used to develop typical revenue and expense estimates for various crops currently grown in the impact area of influence. The analysis reflects typical business practices for Wasatch County farming operations that would be affected by the Proposed Action and alternatives. As a result, these analyses do not estimate effects on any specific or individual farm enterprises or irrigation companies. Production costs and revenue have been weighted to reflect regional conditions. The budgets were based largely on data for Wasatch County from the Utah State University Cooperative Service (G.D. Miller and E.B. Godfrey, 1993).

B.2.11.2.3 Gross Revenue in Other Sectors. Baseline gross revenue from sales in sectors other than the farm (or agriculture) sector was estimated for Wasatch County based on data from the U.S. Bureau of Economic Analysis (Utah Department of Employment Security 1995). Impacts were developed from results of the agricultural resources, mineral and energy resources and recreation analyses. Revenue impacts related to increases in recreational use were estimated by applying expenditure multipliers to the number of recreationists expected to be attracted to the restored streams in the upper Strawberry River basin (Bear West 1993). Gross revenue impacts in each affected sector were then added together to define potential gross revenue impacts at the county level.

Two approaches were used to estimate potential impacts by recreationists on the local economy. The FWS has estimated the regional economic benefit related to increased recreational use using a unit value of $25.96 per angler day (FWS 1996). This angler day unit value was estimated using the contingent valuation methodology. The contingent valuation method typically involves the use of surveys to estimate people's "willingness to pay" for improved recreational conditions, environmental improvements etc. This technique is usually used to place a dollar value on regional environmental benefits that are difficult to quantify. They can then be compared against the costs of a project in benefit cost analyses. A lower and different type of angler day unit value of $18.40 was used to estimate likely impacts in Wasatch County on the gross taxable sales (gross revenues) of retail trade businesses. The $18.40 angler day unit value is based on studies of expenditures by recreationists and does not include the cost of overnight stays. It was assumed that 3 percent of the 203,860 increase in angler days estimated by FWS would generate increased gross revenues in the Wasatch County retail trade sector.

B.2.11.2.4 Income. Baseline income by place of work was estimated for Wasatch County based on data from the U.S. Bureau of Economic Analysis. (U.S. Bureau of Economic Analysis 1994) Income impacts were developed from results of the agricultural resources, mineral and energy resources, and recreation analyses. Construction and operations payroll information provided by the project engineers also was used. Income by place of work impacts were defined for the farm, retail trade and construction sectors of the Wasatch County economy. Income by place of work was used instead of personal income because personal income includes all sources, while income by place of work is a better measure of impacts related to a project. The income impacts in each affected sector were then added together to define potential regional income impacts at the county level. A percentage difference from baseline was calculated and compared with the significance criteria discussed in Section 3.12.7.1 in the WCWEP and DRP EIS.

B.2.11.2.5 Employment. Estimated changes in employment by sector were compared with related baseline estimates. A percentage difference from baseline was calculated and compared with the significance criteria discussed in Section 3.12.7.1 in the WCWEP and DRP EIS. Baseline employment was estimated by sector for Wasatch County based on data from U.S. Bureau of Economic Analysis (U.S. Bureau of Economic Analysis 1994). Employment impacts were estimated from the results of the agricultural resources, mineral and energy resources and recreation analyses. Permanent employment impacts were assessed at the regional level.

Table B-2
Example Cost of Production for Sprinkler Irrigated Alfalfa Hay

	Cost ($/Acre)				
Item	**Material**	**Equipment**	**Labor**	**Subtotal**	**Income ($/Acre)**
PRODUCTION COSTS					
Variable Costs:					
Fertilizer:					
Material					
Application					
Insecticide:					
Material					
Application					
Irrigation:					
Water Shares					
Water, Sup.					
Operation					
Harvest:					
Swath					
Turn					
Bale					
Haul					
Management					
Interest @8.00%					
Overhead @ 5.0%					
Subtotal					
Fixed Costs:					
Equipment				0.00	
Irrigation System				0.00	
Stand					
Subtotal					
Total Prod. Cost					
INCOME					
Hay @ 4.5 Ton					
Subtotal					
Net Profit/<Loss>					

B.2.11.2.6 Public Services and Related Fiscal Impacts. Baseline public services and related fiscal conditions were defined based on personal interviews with local officials and planning documents. The SOPs described in Section 1.12.9 in the WCWEP and DRP EIS and construction procedures were reviewed to identify which types of public services and agencies might be impacted after the SOPs are successfully implemented. Fiscal impacts related to potential changes in sales were quantified using state and local tax rates, while impacts on income and property tax revenue were addressed qualitatively.

The impact on property tax revenues was estimated by considering those private lands that would be acquired in the course of constructing the projects. An annual decrease in property tax revenues was estimated by considering the 1995 Wasatch County county-wide mill levy and the percentage of market value applied to that mill levy for property tax purposes. Both agricultural and secondary residence properties pay property taxes based on 100 percent of the market value of the property. It was assumed for this analysis that lands acquired would have a market value of $40,000 per acre. This is based on current land values and extrapolation of trends in land values evident in Heber Valley.

Property tax revenue impacts were adjusted for payments in lieu of taxes that are expected to be available to Wasatch County from the Federal government (BLM 1996). Using a 1996 payment in lieu of taxes rate of $1.11 per acre (BLM 1996), a net property tax revenue impact was calculated. It was also confirmed that Wasatch County had not reached its payments in lieu of taxes cap and should, therefore, be eligible for additional payments in the future.

B.2.11.2.7 Housing. The engineering team believes 25 percent of the construction work force would reside locally, with the remainder commuting from Salt Lake City, Provo, Orem, Park City and other nearby communities. Therefore, no additional analysis of potential housing impacts was necessary.

B.2.11.2.8 Social Impacts. Potentially-affected social groups were defined and described. These groups consist of individuals who would be affected in a similar manner by the Proposed Action and alternatives. The groups often overlap because some individuals have interests and concerns that place them in more than one group. For example, a farmer also may be a recreationist, conservationist or local property owner. Members of each social group would likely experience common impacts on their lifestyles, behavior, attitudes, values and general well-being.

Social impacts were identified and characterized by reviewing detailed descriptions of the Proposed Action and alternatives, findings of other socioeconomics impact topics and results of the agriculture, recreation, noise, health and safety and transportation analyses. The analysis also included a review of the social assessment guidelines of the USFS and U.S. Bureau of Land Management (BLM), and documentation of scoping-related meetings with Heber Valley farmers, land owners and other interested individuals.

B.2.12 Health and Safety

B.2.12.1 Assumptions

The health and safety analysis assumed the transportation, health and safety, air quality and noise SOPs would be successfully implemented. It also assumed that WCSSA or the CUWCD would operate all water conveyance and delivery systems associated with the WCWEP and DRP, using the supervisory monitoring system discussed in Section 1.8.6 of the WCWEP and DRP EIS.

B.2.12.2 Impact Topic Analysis Methods

B.2.12.2.1 Construction Hazards. Hazards related to construction traffic were assessed by using the results of the transportation analysis and reviewing the related transportation SOPs. Other hazards to construction workers and the general public during construction were assessed by reviewing construction procedures for the Proposed Action and alternatives and the health and safety, noise and air quality SOPs.

B.2.12.2.1 Construction Hazards. Hazards related to construction traffic were assessed by using the results of the transportation analysis and reviewing the related transportation SOPs. Other hazards to construction workers and the general public during construction were assessed by reviewing construction procedures for the Proposed Action and alternatives and the health and safety, noise and air quality SOPs. The SOPs were then compared against the USBR safety and health manual (USBR 1993) to determine if they would sufficiently protect workers and the general public.

B.2.12.2.2 Hazards Related to Flooding From Streams and Canals. Potential flooding risks associated with affected streams and canals were assessed by reviewing related design features of the Proposed Action and alternatives, the water resource analysis results, and local agency responsibilities for planning and preserving flood control facilities.

B.2.12.2.3 Potential Failure of Pipelines, Canals and Regulating Ponds. A "worst-case" approach was used to assess potential risks and damages associated with potential pipeline and regulating pond failures. Potential inundation areas and the duration of possible facility failures were defined and described under worst-case assumptions.

B.2.12.2.4 Other Hazards During Operation. Potential risks to the public from conveyance of water by the Proposed Action and alternatives in open canals and the Proposed Action's supplemental streamflows were assessed. The related features and operational plans of each alternative were reviewed along with the health and safety SOPs. Factors considered were the location of fencing and grating, and changes in the depth and velocity of affected canals and streams. The results of the transportation analysis also were reviewed.

B.2.13 Noise Analysis Methodology

B.2.13.1 Assumptions

The following assumptions were used during the noise analysis:

- Typical noise levels associated with construction activities and defined in the Handbook of Noise Control (Harris 1979), represent the noise impacts of the Proposed Action and DRP alternatives during construction

- The noise mufflers on equipment, structures around pumping stations and other noise muffling measures would be function properly

- Sensitive noise receptors are in the same location under baseline conditions as they are under existing conditions (sensitive receptors are locations especially susceptible to noise impacts, such as schools, hospitals, nursing homes and residences)

B.2.13.2 Impact Topic Analysis Methods

The proposed construction procedures were reviewed to identify activities that would generate noise. Typical construction noise levels were defined by the project engineering team. Project definition maps showing proposed pipeline alignments and canal modifications were reviewed to determine the proximity of potential construction activities to sensitive noise receptors. The location of recreation traffic that would be generated by the Proposed Action and DRP alternatives was defined based on a review of the transportation analysis results in Section 3.18 of the WCWEP and DRP EIS. Noise significance criteria were defined and based on studies by the EPA (1971) and CEQ (1970). The projected noise levels associated with the Proposed Action and DRP alternatives were compared to these criteria to determine the potential for significant noise impacts.

B.2.14 Visual Resources Analysis Methodology

B.2.14.1 Assumptions

Baseline conditions are assumed to be the same as existing conditions for visual resources. The character of the valley changes with the four seasons and the hydrology is related to particular years, therefore the natural landscape is always changing.

B.2.14.2 Impact Topic Analysis Methods

There are no established visual quality objectives or scenic standards for lands not managed by the federal government in Wasatch County. The majority of the land in the WCWEP and DRP impact area of influence is privately owned, so the evaluation focused on landscape character attributes from middle ground and background views.

The potential for impacts on landscape character attributes was measured by the capability of the landscape to absorb visual alteration without losing its existing character. Existing landscape character attributes include form, line, color and texture. Project-related changes in baseline landscape character attributes were described.

The visual analysis focused on critical viewpoints (locations where a large number of viewers, relative to other viewpoints in the study area, are affected by the project). The critical viewpoints that were used during the analysis are: Highway 40 hillside grade at the north end of the valley looking south, Valley Hills subdivision and Memorial Hill. These viewpoints were chosen for the analysis because they have an elevated view that includes most of Heber Valley from three different perspectives, but most of the minor visual impacts on color, texture, line and landform are not seen from these viewpoints. Only a small number of viewers traveling secondary roads would observe the potential insignificant visual impacts from construction of the Proposed Action and DRP alternatives.

In addition to the number of viewers impacted by the project, the analysis considered the expected duration of potential visual impacts, e.g., temporary, construction-related impacts versus permanent visual changes.

B.2.15 Recreation Analysis Methodology

B.2.15.1 Assumptions

The following assumptions are part of the recreation analysis methodology related to angler use:

- An angler day is equal to 2.6 hours of fishing plus travel time (FWS 1993)
- It takes two hours to catch and creel one wild fish from Heber Valley streams, which is equal to 0.77 angler days (1 fish/2 hr) 2.6 hr
- It takes 0.5 hour to catch and creel one stocked fish from Daniels Creek, which is equal to 0.19 angler days
- The proportion of the total wild trout population creeled annually by anglers would be 30 percent on Heber Valley streams (FWS 1993)
- The proportion of the total stocked trout population creeled annually by anglers would be to 70 percent on Daniels Creek

- Fisheries management policies for Heber Valley streams would promote natural production of wild trout with minimal introduction of stocked, hatchery-produced trout

- A creeled fish is equivalent to a harvested fish

- Anglers would make day trips to fish Heber Valley streams but would not spend the night in Heber Valley

- The fishing season in Heber Valley generally runs early March to the end of November (270 days)

- It is assumed that 1 pound of trout equals four wild or three stocked fish for Daniels Creek

- The Utah State Comprehensive Outdoor Recreation Plan identifies a high demand for fishing opportunities, therefore the assumption was made that fishing pressure will increase relative to the increase in production from improvements in habitat carrying capacities

B.2.15.2 Impact Topic Analysis Methods

B.2.15.2.1 Changes in Recreation Use. Changes in recreation use were evaluated in terms of changes in angler days because fishing is expected to be the predominant recreation activity associated with the Proposed Action and alternatives. The potential decrease in the number of angler days along Daniels Creek from decreased flows was evaluated by applying a formula first utilized by the (U.S. Fish and Wildlife Service (FWS) in the Diamond Fork Power System analysis. That methodology is documented in the March 1993 report prepared by the FWS Salt Lake City Field Office, Division of Ecological Services, titled *Evaluation of Fish & Wildlife Resources & Mitigation Recommendations for the Diamond Fork Power System, Bonneville Unit Central Utah Project* (pages 6-8).

The following general equation for angler-use carrying capacity has been adopted for the recreation analysis on Heber valley streams:

$Y = AD/yr = (X_1)(X_2)(X_3)$
where
AD/yr = Angler Days per Year
X_1 = Pounds of fish in the streams
X_2 = Fish stocking rate (number of fish per pound)
X_3 = Minimum angler-days per creeled fish at angler-use carrying capacity

Example: 150 (pounds of fish) x 1.9 (fish per pound) x .30 (creel rate) x 0.77 (1 fish caught per 2 hrs. and 2.6 hrs. is one angler day) = 65.8 angler days/yr

The Utah Division of Wildlife Resources provided information from a FWS memorandum that projected an increase of 10,000 angler days an year in the upper Strawberry River and its tributaries after restoration of natural flows to the upper Strawberry River basin.

B.2.15.2.2 Physical Impacts on Recreation Areas. The locations of existing recreation areas in the impact area of influence were defined. Potential conflicts with existing and proposed recreation areas were assessed for each action alternative by determining the potential for the Proposed Action and alternatives to damage or restrict access to facilities.

B.2.15.2.3 Impacts on Recreation Quality. Potential impacts on the quality of recreation opportunities at existing and proposed recreation areas was assessed qualitatively. This part of the analysis used the results of the analyses associated with the other two recreation impact topics. Impacts on the quality of recreation in affected areas also was assessed by considering such factors as changes in privacy or the number of recreationists visiting an area; a change in the quality of fishing; nuisances such as noise and air quality impacts; and visual impacts.

B.2.16 Cultural Resources Analysis Methodology

This section describes the cultural resources analysis methodology. A more detailed discussion is presented in the Draft Cultural Resources Technical Report (CUWCD 1996f).

B.2.16.1 Assumptions

The cultural resources analysis assumed that sampling of the impact area of influence in Heber Valley, using limited field assessment, would provide sufficient data to conduct the impact analysis. The analysis also assumed an intensive cultural resources survey would be conducted of areas that would be disturbed by construction before beginning work. A Programmatic Agreement (PA) has been developed between the Utah State Historic Preservation Office (SHPO) and CUWCD to guide the intensive cultural resources survey and documentation of survey results.

B.2.16.2 Impact Topic Analysis Methods

B.2.16.2.1 Cultural Resources. Analysis of potential impacts on cultural resources is based on research from pre-existing historical and prehistorical data for the impact area of influence, limited field sampling in Heber Valley, and detailed field sampling in the upper Strawberry River basin. The first phase of research involved compiling known archaeological and historic site information and preparing prehistoric and historic overviews of the impact area of influence. These overviews were used as contextual tools for evaluation of recorded and unrecorded cultural resource sites. Existing information was gathered from files of the SHPO, cultural resources files of the Uinta National Forest Supervisor's Office in Provo, and historic files at the CUWCD in Orem. This first phase defined baseline conditions.

The second phase of research involved limited field assessment of selected historic features that could be impacted under the Proposed Action and DRP alternatives. Portions of several canals were evaluated for potential impacts and significance of cultural resource sites, including the Timpanogos, Wasatch, and Sagebrush and Spring Creek canals. These sites were not formally recorded, but information was collected to establish the general nature of cultural resources associated with these canals. Potential changes to these sites under the Proposed Action and DRP alternatives were compared to baseline conditions to determine impacts on cultural resources.

The third phase of research involved a detailed inventory of the DIC diversion facilities in the upper Strawberry River basin. The inventory consisted of documenting existing cultural resources along the canals and determining eligibility of the sites for inclusion on the National Register of Historic Places (NRHP). These sites were evaluated using NRHP criteria, resulting in definition of baseline conditions. Changes to these sites under the Proposed Action and DRP alternatives were compared to baseline conditions to determine impacts on cultural resources.

B.2.16.2.2 Paleontological Resources. Analysis of potential impacts on paleontological resources consisted of literature searches and a limited sample survey of exposed fossiliferous geologic formations. Literature searches were conducted at the Utah Field House of Natural History, University of Utah, Brigham Young University, Utah Division of State History, Office of the State Paleontologist, USGS and Utah Geological Survey. The results of the literature search established baseline conditions, and changes under the Proposed Action and DRP alternatives were then analyzed to determine potential impacts on paleontological resources.

B.2.17 Transportation Analysis Methodology

B.2.17.1 Assumptions

The transportation analysis assumed Highways 40 and 189 would be the primary routes used by construction vehicles to access construction sites. Highways 40 and 189 provide access from Salt Lake City and the Provo/Orem areas, respectively, and are shown on Map A-1 (see pocket at back of EIS). About 75 percent of the workers would commute from the Salt Lake City and Provo/Orem areas, and the remainder from local Wasatch County communities. It was assumed an equal number of workers would come from the Salt Lake City and Provo/Orem areas. Smaller, local roads also would be used, but for much shorter periods compared to Highways 40 and 189. It also was assumed that one construction worker per vehicle would travel to the construction sites. All borrow material would come from the Bingelli gravel site off Highway 189, and all pipeline material would come from the Salt Lake City area via Highway 40.

Recreationists would use most of the same roads used by construction traffic to access streams that would receive supplemental flows under the Proposed Action.

Baseline traffic estimates were prepared by assuming a 5 percent annual growth rate in traffic each year from 1992 (the last year of historic Utah Department of Transportation data available) to 2000 (the year used to help represent baseline conditions in this EIS). The annual growth rate is based on historic and projected Utah Department of Transportation (UDOT) traffic data for the study area.

B.2.17.2 Impact Topic Analysis Methods

The estimated construction- and operation-related traffic was compared against baseline traffic estimates to quantify traffic impacts on Highways 40 and 189, the only two roads in the study area for which historic data exist. Traffic impacts on smaller roads were assessed qualitatively and by reviewing results of another EIS study conducted in Heber Valley because historic data were not available to develop baseline traffic estimates.

The project engineering team provided estimates of the total and peak daily traffic that would be generated by construction and O&M activities. The team also identified road crossings and sources of borrow and pipe material.

Baseline conditions on Highways 40 and 189 were established using UDOT's Annual Average Daily Traffic (AADT) data from 1992 (UDOT 1992). These data and projections to the year 2015 were reviewed to determine an annual growth rate of 5 percent. This growth rate was applied to the last year of available historic data (1992) to estimate baseline traffic in the year 2000. An average of the AADT data between affected mileposts was used to define baseline conditions.

Peak daily traffic estimates related to construction and operation of the Proposed Action and DRP alternatives were applied to the Highway 40 and 189 baseline traffic estimates. The analysis defined the maximum increase in average daily traffic on each highway, given expected construction activities and related assumptions defined in Section B.2.17.1. The assessment of potential impacts on smaller roads was qualitative, based on professional judgment and a review of the transportation SOPs in Section 1.12.9 of the WCWEP and DRP EIS.

B.3 PRRP Analysis Methodologies

The analysis methodologies are provided by resource in the order they appear in Chapter 3 of the PRRP EIS.

B.3.1 Water Resources Analysis Methodology

The water resources analysis methodology includes assumptions and impact topic analysis methods for surface water and groundwater. A more detailed discussion is presented in the Draft Water Resources Technical Report (CUWCD 1996c).

B.3.1.1 Assumptions

The assumptions used to model baseline conditions, and the Proposed Action and PRRP alternatives were the same as the assumptions used to model the WCWEP and DRP baseline and alternatives described in Section B.2.1.1 of this appendix, with one additional assumption. It was assumed the water supply for side channel flows under the Proposed Action would be Provo River flow bypassed through the channels and back into the Provo River. These side channels would be 1,000 feet or less from the centerline of the Provo River. Therefore, no changes in releases from Jordanelle Reservoir would be required to provide flows for the side channels. Flows in the main channel of the Provo River could be less than the minimum instream flow requirement of 125 cfs, as long as the combined total flow of the main channel and any side channels conveying bypassed river flows was at least 125 cfs at all locations between Jordanelle and Deer Creek reservoirs.

B.3.1.2 Impact Topic Analysis Methods

The methods used to model baseline conditions in this analysis were the same as described in Section B.2.1.2 of this appendix. Baseline conditions used in this analysis are future conditions that would occur when Jordanelle Reservoir becomes fully operational and reaches full water demand levels, as set forth in the Bonneville Unit M & I System Final Supplement to the Final Environmental Statement (USBR 1987) completed before construction of the reservoir. Therefore, water diversions and Provo River flows under baseline are not existing conditions. They are future conditions that would occur as a result of the construction and full operation of Jordanelle Reservoir.

No additional surface water modeling was conducted for the PRRP Proposed Action and alternatives because there would be no changes in releases from Jordanelle Reservoir or in diversions from the river.

The Proposed Action's groundwater resource impacts were modeled with a groundwater model (MODFLOW). River reach lengths, elevations and stages under the Proposed Action were changed in the model from baseline conditions. The Existing Channel Modification and Instream Structures alternatives were not modeled for groundwater changes because they do not have the potential to significantly change the Provo River's flow, grade or flow depth.

B.3.2 Water Quality Analysis Methodology

This section describes the water quality analysis methodology. A more detailed discussion is presented in the Draft Water Quality Technical Report (CUWCD 1996e).

B.3.2.1 Assumptions

The water quality analysis assumes the impacts of existing nonpoint source pollution practices are reflected in the existing water quality monitoring data. Activities under baseline conditions and the PRRP are not expected to expand or otherwise change existing nonpoint pollution sources.

The water quality analysis assumes the parameters are conservative and that water quality changes can be estimated with mixing and dilution. The parameters are considered conservative because it is assumed they would not change forms, for example, NO_3 to nitrite.

Assumptions used for determining baseline conditions for the Provo River discharge from Jordanelle Reservoir are the same as those described in Section B.2.2.1 of this appendix.

It was assumed the amount of solar radiation reaching the surface of the Provo River in a specific reach is inversely proportional to the percentage of the reach that has riparian vegetation. This approach is conservative with respect to identifying impacts because it assumes all existing riparian vegetation provides shading, and the loss of that riparian vegetation would increase solar radiation.

It was assumed the daily average water temperature data collected for the Provo River above Deer Creek Reservoir in 1993 and 1994 by the JTAC represents baseline equilibrium temperatures. This assumption is appropriate because the transition zone analysis completed for the WCWEP and DRP EIS concluded late summer releases from Jordanelle Reservoir would reach equilibrium with ambient meteorological conditions and groundwater return flow within a short distance below the dam.

B.3.2.2 Impact Topic Analysis Methods

Existing water quality conditions in the PRRP impact area of influence were defined and adjusted to develop baseline conditions using the same approach described in subsection B.2.2.2 of this appendix. An exception is the PRRP temperature analysis. Existing temperature conditions were evaluated using hourly data collected from the Provo River by JTAC during 1993 and 1994. These data were combined with streamflows for the Provo River and used to identify water temperatures in Reach 2 under existing conditions. These temperatures were identified for specific dates during late summer when flows were similar to flows anticipated for a dry year under baseline conditions. Late summer meteorological conditions combined with dry year flows represent a worst-case high-temperature condition. The following heat balance equation from Thomann and Mueller (1987) was then used to estimate temperatures in the other reaches, based on a ratio of the percent riparian vegetation in Reach 2 to the percent in the other reaches:

$$T_e = T_d + H_s/K$$

where:

T_e = Equilibrium temperature (°C)
T_d = Dewpoint temperature (°C)
K = Estimated average surface heat exchange coefficient (cal/cm^2 day°C))
H_s = Short-wave radiation (cal/(cm^2 day)

For example the monitored average daily water temperature in Reach 2 on July 26, 1993 was 55.8°F (13.2°C). The average dew point temperature for Salt Lake City on July 26, 1993 was 50°F (10°C) (NOAA, 1993). Correcting the dew point temperature for the elevation of the Heber Valley with a correction factor of 2.2°F per 1,000 feet (Peck 1967) gives a corrected dew point temperature for the Heber Valley of 46.9°F (8.3°C). Solving for H_s/K for Reach 2 gives:

$$H_s/K_{(\text{Reach } 2)} = 13.2°\text{C} - 8.3°\text{C} = 4.9°\text{C}$$

The length of channel in Reach 2 is 5,400 feet, of which the average length of each bank that has riparian vegetation is 3,590 feet, or 66 percent of the total reach length. Reach seven has a length of 4,500 feet of which the average length of each bank with riparian vegetation is 4,130 feet, or 92 percent of the total length. Weighting the H_s/K function in Reach 2 by the percentage of vegetation in Reach 7 gives an H_s/K function for Reach 7 as:

$$H_s/K_{(\text{Reach } 7)} = (1 - (0.92 - 0.66)/0.66) \times 4.9°\text{C} = 3.0°\text{C}$$

The equilibrium temperature under baseline in Reach 7 then equals:

$$T_e = 8.3°\text{C} + 3.0°\text{C} = 11.3°\text{C}\ (52.3°\text{F})$$

The potential for the PRRP to increase TSS and TP loads and concentrations in the Provo River was largely based on the potential of the Proposed Action and alternatives to cause channel erosion and erosion from construction activities. An evaluation of the potential for erosion during construction and during the long-term is presented in Section 3.8 of the PRRP EIS.

Potential changes in TSS and TP loads and concentrations also were assessed by evaluating the amount and type of land to be acquired under each of the Proposed Action and alternatives, which varies (see Section 1.11.1, Table 1-10 of the PRRP EIS). However, all of the land acquired for public access corridors would be fenced, which excludes livestock and promotes the change from pasture to more natural open space. TP loads would change from a baseline export rate associated with pasture to one associated with open space and forest. Export rates from Olem and Flock (1990) indicate that this change could decrease TP loads by 1.48 kilograms per acre per year (kg/ac/yr). This export rate was used to estimate the reduction in TP loads associated with each alternative.

The potential for PRRP construction activities to impact TP and NO_3 loads from septic systems was evaluated by reviewing the design criteria for the PRRP and comparing them with an inventory of septic systems compiled by Hansen, Allen, and Luce (1994).

The approach used for evaluating potential water temperature impacts of the Proposed Action and alternatives was designed to isolate the effects of changes in shading in each reach of the Provo River. This approach was very conservative with respect to identifying temperature increases because it assumes all existing riparian vegetation provides shading and that the loss of that riparian vegetation would increase solar radiation, when in fact existing vegetation does not provide effective shading along much of the river. The water temperature analysis was conducted for the late summer period of a dry year — a worst-case, high-temperature period.

The channel length with riparian vegetation remaining in each reach after construction was estimated using the preliminary design drawings of the Proposed Action and alternatives. The baseline heat balances for each reach were then weighted by the percentage change in the length of riparian vegetation remaining to estimate equilibrium temperatures for each reach and alternative. The length of riparian vegetation remaining in each reach for the Proposed Action was divided by the new reach length to account for increased reach lengths under the Proposed Action. For example Reach 7 under the Proposed Action will be 4,982 feet long. Existing riparian vegetation would not be cleared from 47 percent of this reach. Therefore, the new H_s/K function for Reach 7 would be:

$$H_s/K_{(\text{Reach } 7)} = (1-(0.47- 0.66)/0.66)\text{x } 4.9°\text{C} = 6.3°\text{C}$$

and the estimated equilibrium temperature in Reach 7 under the Proposed Action is:

$$T_e = 8.3°\text{C} + 6.3°\text{C} = 14.6°\text{C } (58.3°\text{F})$$

The analysis addressed long-term water temperatures after re-establishment of cottonwood trees and other riparian vegetation included in the Riverine Habitat Restoration and Existing Channel Modification alternatives. The approach for considering long-term changes considered revegetation, the magnitude of the short-term increases, and the fact that meteorological conditions would not be altered by the alternatives.

Analysis of the potential to increase sediment loading and eutrophication in Deer Creek Reservoir was completed using the Provo River nutrient and sediment assessment described above and results of the eutrophication model described in Section B.2.2.2 of this appendix.

The water quality analysis contains several uncertainties. These are the result of the uncertainty and variation in the existing monitoring data, the uncertainty in predicting future conditions after Jordanelle Reservoir is fully operational and the uncertainties in data from other related disciplines used in this analysis (i.e., water resources, soils and agriculture). Therefore, throughout the water quality analysis, conservative methodologies were used to help address uncertainties and to take a conservative approach in identifying adverse impacts.

B.3.3 Wetlands Analysis Methodology

This section describes the wetlands analysis methodology. A more detailed discussion is presented in the Draft Wetlands Technical Report (CUWCD 1996d).

B.3.3.1 Assumptions

The assumptions used in the wetland impact analysis are the same as those described in Section B.2.3.1 of this appendix.

B.3.3.2 Impact Topic Analysis Methods

Potential construction-related impacts were evaluated for each alternative by superimposing the engineering plans for the Proposed Action and PRRP alternatives on baseline wetland maps. The resulting overlay was used to identify any specific wetland types that would be directly impacted during the long-term by removal of vegetation and soil disturbance associated with construction of a new river channel, side channels, setback dikes and floodplain grading. These areas were reviewed and measured in the field to develop an estimate of impacted wetlands. Additional wetland areas in the construction corridor were reviewed that would be directly impacted during the short-term by the operation of construction equipment.

B.3.4 Aquatic Resources Analysis Methodology

This section describes the aquatic resources analysis methodology. A more detailed discussion is presented in the Draft Aquatic Resources Technical Report (CUWCD 1996a).

B.3.4.1 Assumptions

The aquatic resources analysis assumed that baseline conditions include a 125 cfs minimum instream flow in the Provo River. The analysis of potential impacts assumed the results of the Binns HQI Model II that show changes in aquatic habitat features are generally applicable to non-game fish and other aquatic resources.

B.3.4.2 Impact Topic Analysis Methods

B.3.4.2.1 Game Fish and Their Habitat. Potential impacts on game fish and their habitat in the Provo River were analyzed using the same methods described in Section B.2.4.2.1 of this appendix. Additional analysis methods for Provo River game fish and their habitat are described in the following paragraphs and include a definition of baseline conditions, analysis of the quantity of trout habitat created under the Proposed Action and alternatives, and use of monitoring information from previous stream restoration projects.

Aquatic resources field surveys were conducted in the Provo River in July 1993. Results of these surveys reflect existing conditions in the Provo River without the 125 cfs minimum instream flow that would be established under baseline conditions. Therefore, the 1993 survey results underestimate baseline aquatic habitat and fish use.

The Binns (HQI) Model II was used to estimate baseline conditions with 125 cfs minimum instream flow (see Section B.2.4.2.1.2 of this appendix). The habitat attribute ratings for late summer flow and annual streamflow variation that were assigned based on the 1993 field surveys were modified to reflect optimal instream flows under baseline conditions. The resulting HQI scores with these adjusted habitat attribute ratings were used as the values for baseline conditions.

Typical pool and riffle cross-sections were analyzed to determine the area of trout habitat provided for the Proposed Action and alternatives. The amount of pool and riffle area created under the Proposed Action and alternatives was compared to baseline conditions to identify any changes.

Monitoring data from stream habitat enhancement projects in and along two other rivers were reviewed to help assess the potential benefits to be expected over time within the Provo River under the Proposed Action and alternatives. Post-restoration monitoring data, including improvements to habitat quality and its subsequent change over time, increases or decrease in trout standing crop, and revegetation of the riparian zone were evaluated. Documented improvements in habitat quality, increases in trout standing crop, and riparian zone recovery were used to justify the predicted changes in the habitat quality attributes under the Proposed Action and alternatives.

B.3.4.2.2 Non-Game Fish and Their Habitat. Impact analysis methods for non-game fish and their habitat in the Provo River are the same as described in Section B.2.4.2.2 of this appendix.

B.3.4.2.3 Other Aquatic Resources. Impact analysis methods for other aquatic resources in the Provo River are the same as described in Section B.2.4.2.3 of this appendix.

B.3.5 Wildlife Resources Analysis Methodology

This section describes the wildlife resources analysis methodology. A more detailed discussion is presented in the Draft Wildlife Resources Technical Report (CUWCD 1996g).

B.3.5.1 Assumptions

The wildlife resources assumptions are the same as described in Section B.2.5.1 of this appendix.

B.3.5.2 Impact Topic Analysis Methods

Impact topic analysis methods are the same as described in Section B.2.5.2 of this appendix.

B.3.6. Threatened and Endangered Species Analysis Methodology

This section describes the T&E species resources analysis methodology. A more detailed discussion is presented in the Draft Threatened and Endangered Species Technical Report (CUWCD 1996b).

B.3.6.1 Assumptions

The assumptions used for the T&E analysis are the same as those described in Section B.2.6.1 of this appendix.

B.3.6.2 Impact Topic Analysis Methods

The impact topics that were used to determine effects on peregrine falcon, bald eagle, Ute ladies'-tresses, spotted frog and other T&E species are the same as those described in Section B.2.6.2 of this appendix.

B.3.7 Soil Resources Analysis Methodology

B.3.7.1 Assumptions

Baseline soil conditions are assumed consistent with characteristics described in the published Soil Survey for the Heber Valley.

B.3.7.2 Impact Topic Analysis Methods

B.3.7.2.1 Soil Erosion and Stability. The engineering layouts for the Proposed Action and alternatives were reviewed to identify the location of potential stream channel modifications and where changes to soil resources could occur. Construction-related information from the PRRP engineering team was used to assess potential impact of construction activities on soil erosion. The erosion-related SOPs were reviewed to determine the potential for erosion after the SOPs are implemented.

B.3.7.2.2 Soil Quality. The PRRP soil quality analysis methods were the same as those described in Section B.2.7.2.2 of this appendix.

B.3.8 Mineral and Energy Resources Analysis Methodology

B.3.8.1 Assumptions

Energy consumption during construction is assumed to include the energy used by construction equipment, spoil disposal, hauling borrow material, and workers' commuting vehicles. Construction equipment is assumed to consume gasoline at typical rates.

B.3.8.2 Impact Topic Analysis Methods

B.3.8.2.1 Mineral Resources in Heber Valley. Mineral resource sites in Heber Valley were identified and the project engineering staff helped define the amount, type and location of borrow and spoil material to be used by the Proposed Action and alternatives. The ability of the existing mineral resource sites to supply the material was determined by project engineers. Construction procedures and results of the transportation analysis were reviewed to determine if the Proposed Action and alternatives would interfere with extraction of minerals from mineral resource sites.

B.3.8.2.2 Energy Used During and After Construction. Typical energy consumption factors were applied to estimate the energy that would be used by construction procedures and construction traffic. Because each of the PRRP alternatives would be naturally maintained, no energy would be used for O&M. A qualitative assessment of the energy that would be used by recreationists after construction was conducted.

B.3.9 Air Quality Analysis Methodology

The PRRP air quality analysis methodology is the same as described in Section B.2.9 of this appendix.

B.3.10 Agriculture Analysis Methodology

B.3.10.1 Assumptions

The assumptions are the same as those described in Section B.2.10.1 of this appendix. The cropland in the Provo River corridor is assumed to be irrigated pasture.

B.3.10.2 Impact Topic Analysis Methods

B.3.10.2.1 Livestock Grazing and Production. Analysis methods are the same as those defined in Section B.2.10.2.1 of this appendix.

B.3.10.2.2 Cropland and Crop Production. Land use data in the Utah Department of Natural Resources Land Use Inventory Report and the SCS Preliminary Investigation Reports were used as the basis for characterizing the existing agricultural cropping pattern in the Provo River corridor. Analysis methods for crop yield and grazing capacity are the same as those defined in Section B.2.10.2.3 of this appendix.

The preliminary engineering layout for the Proposed Action and PRRP alternatives was reviewed and used to identify potentially affected grazing land and croplands along with related practices and operations. Potential changes to agricultural practices and operations such as fertilizer and pesticide applications, property access, alterations to facilities and disruptions to livestock grazing patterns were analyzed. Data from the soils discipline were used to assess potential impacts on grazing land and cropland related to soil quality and construction activities.

B.3.11 Socioeconomics Analysis Methodology

B.3.11.1 Assumptions

Most of the assumptions and analysis methods described in Section B.2.11.1 of this appendix apply to the PRRP socioeconomic analysis. This section describes those assumptions and methods that are unique to the PRRP analysis.

It was assumed that anglers and other recreationists attracted to the Provo River after construction of the Proposed Action and alternatives would spend an average of $18.40 per angler day in Heber Valley during their visit. They would not spend the night, since Heber Valley is a short drive from nearby urban areas. Therefore, the recreation expense multiplier does not include a lodging-related expense factor.

It was assumed that agricultural operations would be the only types of businesses that would experience a reduction in revenue during the construction of the PRRP.

The water supply and rate assumptions defined in Section B.2.11.1 of this appendix were not used in the PRRP analysis because it would not impact water supplies or rates.

B.3.11.2 Impact Topic Analysis Methods

Most of the impact topic analysis methods are the same as described in the Section B.2.11.2 of this appendix.

A unique aspect of the socioeconomics methodology involved assessing impacts on agricultural production and economics from a periodic increase in flooding under the Proposed Action and Existing Channel Modification Alternative. Agricultural lands that would be periodically inundated along the Provo River were defined with the assistance of the project engineers. The amount of land inundated under 2-, 10- and 100-year flood events was estimated along with the related loss of agricultural revenue. It was assumed inundated lands would likely not be usable for half of the growing season, thus reducing grazing land and cropland (irrigated pasture) yields by 50 percent.

B.3.12 Health and Safety Analysis Methodology

B.3.12.1 Assumptions

The health and safety analysis assumed the transportation, health and safety, air quality and noise SOPs would be successfully implemented. The flood frequency analysis assumed historic hydrology is representative of future hydrology.

B.3.12.2 Impact Topic Analysis Methods

B.3.12.2.1 Construction Hazards. Analysis methods are the same as those defined in Section B.2.12.2.1 of this appendix.

B.3.12.2.2 Hazards Related to Flooding. An analysis was conducted by project engineers to determine the expected frequency of flooding and the area inundated by 2-, 10- and 100-year flood events (flood events that are expected to occur an average of every 2, 10 and 100 years, based on historic hydrology). This information was used to help formulate the Proposed Action and PRRP alternatives, including placement of dikes to contain 100-year flood flows. Potential hazards to people associated with these flood events were identified.

B.3.12.2.3 Other Hazards After Construction. The results of the transportation and recreation analyses were reviewed to assess the potential for accidents related to recreation traffic after construction. The maintenance requirements of the Proposed Action and PRRP alternatives also were reviewed.

B.3.13 Noise Analysis Methodology

The PRRP noise analysis methodology is the same as described in Section B.2.13 of this appendix.

B.3.14 Visual Resources Analysis Methodology

B.3.14.1 Assumptions

It is assumed that the Proposed Action (Riverine Habitat Restoration) and the Existing Channel Modification Alternative would be constructed by reach rather than the entire nine reaches at one time. Construction sequencing is assumed to reduce the amount of visual impacts at any one time. Vegetation is assumed to be established in the upper reaches before the downstream reaches are constructed, limiting short-term impacts to the reach under construction. Cottonwood trees are assumed to take 15 to 30 years to grow to a height comparable with existing mature cottonwoods.

Impacts from the disturbance of vegetation are assumed to be most noticeable during spring, summer and fall months when vegetation is normally colorful and trees and shrubs are foliated. Visual changes from the new channel alignment under the Proposed Action are assumed to be visible year-round because the sinuosity of the river would be most noticeable during winter when the trees are defoliated.

It is assumed that short-term visual impacts are those that would occur during construction of the project and would be reduced as the disturbed areas become revegetated. Long-term impacts are assumed to be permanent changes in the landscape character or those that occur over the duration of the project such as realignment of the river channel under the Proposed Action and alternatives.

B.3.14.2 Impact Topic Analysis Methods

Visual resource impact topic analysis methods are the same as those defined in Section B.2.14.2 of this appendix.

B.3.15 Recreation Resources Analysis Methodology

B.3.15.1 Assumptions

The Utah State Comprehensive Outdoor Recreation Plan identifies a high demand for fishing opportunities, so it is assumed that fishing pressure would increase relative to the increase in production from improvements in aquatic resource habitat carrying capacity.

The predominant recreation activities likely to occur along the river corridor are assumed to be angling and pedestrian traffic, which includes walking, jogging and wildlife observation.

An angler day is assumed to equal 2.6 hours of fishing plus travel time.

B.3.15.2 Impact Topics Analysis Methods

Recreation resource impact topic analysis methods are the same as those defined in Section B.2.15.2 of this appendix.

Provo River angler days were calculated using the net increase in wild fish input in the following formula: Net increase in pounds of wild fish x 1.3 fish per pound x 0.69 (proportion of fish caught) x 0.40 angler days, which is equal to a catch rate of 1.05 fish per hour.

B.3.16 Cultural Resources Analysis Methodology

The PRRP cultural resources analysis methodology is the same as described in Section B.2.16 of this appendix.

B.3.17 Transportation Analysis Methodology

B.3.17.1 Assumptions

The transportation analysis assumed Highways 40, 189 and 113 would be the primary routes used by construction workers and equipment to access construction sites. These highways are shown on Map 1-1 and Map A-1 (see pocket at back of EIS). About 75 percent of the PRRP construction workers are assumed to commute to Heber Valley via Highways 40 and 189. These highways provide access from Salt Lake City (Highway 40) and the Provo/Orem areas (Highway 189). About 25 percent of the workers are assumed to commute from local Wasatch County communities. It was assumed an equal number of workers would come from the Salt Lake City and Provo/Orem areas. It also was assumed that one construction worker per vehicle would travel to the construction sites. A site near Highway 189 and Charleston is assumed be the location of all spoil disposal (waste disposal) during construction. Recreationists are assumed to use Highways 40, 189 and 113 for access to the Provo River.

Baseline traffic estimates were prepared by assuming a **3** percent annual growth rate in traffic would occur each year from 1992 (the last year of historic UDOT data available) to 2000 (the year used to define baseline conditions in this EIS). The annual growth rate is based on historic and projected UDOT traffic data for the impact area of influence (UDOT 1992).

B.3.17.2 Impact Topic Analysis Methods

The transportation impact topic analysis methods are the same as described in Section B.2.17.2 of this appendix. The PRRP transportation requirements summarized in Section 1.11.4, Table 1-13 were used in this analysis along with the same UDOT traffic data collected for Highways 40 and 189 during the WCWEP and DRP transportation analysis (see Section 3.18 of the WCWEP and DRP EIS). Additional UDOT traffic data were collected for Highway 113 and River Road since these roads would be used by PRRP construction vehicles.

Appendix C

Endangered, Threatened and Candidate Species Lists

EMPLOYEE FILE

March 3, 1849

United States Department of the Interior

FISH AND WILDLIFE SERVICE

UTAH FIELD OFFICE
LINCOLN PLAZA
145 EAST 1300 SOUTH, SUITE 404
SALT LAKE CITY, UTAH 84115

In Reply Refer To
(ES)

August 16, 1994

Mr. Harold N. Sersland, Environmental Programs Manager
Central Utah Water Conservancy District
355 West 1300 South
Orem, Utah 84058-7303

Dear Harold:

This is in response to your letter of July 20, 1994, which referenced a list of endangered, threatened, and candidate species that may occur in the area affected by the Daniels Replacement, Wasatch County Water Efficiency (DR/WCWEP) and Provo River Restoration (PRRP) projects, that was included in our letter of October 25, 1993. Your letter advised us that the Central Utah Water Conservancy District wishes to prepare separate biological assessments on these two projects, and you asked that we provide you with separate updated lists of endangered, threatened, and candidate species for the projects.

Your letter included a map that delineates the Provo River corridor between Jordanelle and Deer Creek reservoirs, as the area to be addressed in the biological assessment for the PRRP. Recent draft wetland and recreation work plans for the DR/WCWEP have described the project area as Heber Valley between Jordanelle and Deer Creek reservoirs, bounded on the east by the Timpanogos Canal and on the west by Snake Creek and River Ditch.

The overall area for the projects that is now being considered is different than the areas identified in our letter of October 25, 1993.

For purposes of consultation in accordance with the Endangered Species Act, we believe it appropriate to define the area for consultation on the PRRP to include the Provo River corridor between Jordanelle and Deer Creek reservoirs shown on the map that accompanied your July 20, 1994 letter; Deer Creek Reservoir; the Provo River between Deer Creek Reservoir and Utah Lake; and Utah Lake. We also believe it is appropriate to define the area for consultation on the DR/WCWEP as encompassing the same areas as the PRRP; other areas of Heber Valley between Deer Creek and Jordanelle reservoirs, bounded on the east by the Timpanogos Canal and on the west by Snake Creek and River Ditch; areas that will be affected by plans for restoration of historic streamflows in the upper Strawberry River (including Daniels Creek, the upper Strawberry River and other affected tributary streams, and Strawberry Reservoir); and streams of the Uinta River that will receive water that will no longer be diverted to Daniels Creek; and downstream aquatic habitats of the Duchesne and Green rivers.

Attached are lists of endangered, threatened, and candidate species that occur in the two project areas.

Critical habitat for the June sucker was designated in Federal Register Vol. 51, No. 61 on March 31, 1986, and critical habitat for the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker were designated in Federal Register / Vol. 59, No. 54 on March 21, 1994. Copies of these Federal Register documents are enclosed.

Species that are candidates for official listing are identified in Federal Register Vol. 58 / No. 188, dated September 30, 1993, and Federal Register Vol. 56 / No. 225, dated November 21, 1993. All of the Candidate Species except the spotted frog in the enclosed lists are Category 2 Candidates. The spotted frog is a Category 1 Candidate. The Fish and Wildlife Service's 12-month petition finding on the spotted frog was published in Federal Register / Vol. 58 / No. 87 on May 7, 1993 (copy enclosed).

Sincerely,

for Reed E. Harris
Field Supervisor

Enclosures

cc: Director, Utah Division of Wildlife Resources, 1596 West North Temple, Salt Lake City, Utah 84116

Regional Supervisor, Central Region (Attn: John Fairchild), Utah Division of Wildlife Resources, 115 North Main Street, Springville, Utah 84663

Mr. Bob Hurley, CUP Liaison Officer, Uinta National Forest, 88 West 100 North, P.O. Box 1428, Provo, Utah 84603

District Ranger (Attn: Dee Anne Nelson), Heber Ranger District, Uinta National Forest, P.O. Box 190, Heber City, Utah 84038

Mr. Roland Johnston, CUP Completion Act Program Director, U.S. Department of the Interior, P.O. Box 51338, Provo, Utah 84605

Assistant Regional Director (Attn: Grady Towns), Ecological Services, U.S. Fish and Wildlife Service, Denver Federal Center, Denver Colorado / Mail Stop 60120

bcc: Project File
Reading File

FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES WITHIN THE PROVO RIVER RESTORATION PROJECT AREA	
COMMON NAME	SCIENTIFIC NAME
ENDANGERED SPECIES	
Bald eagle	*Haliaeetus leucocephalus*
Peregrine falcon	*Falco peregrinus*
Whooping crane	*Grus americanus*
June sucker	*Chasmistes liorus*
Utah valvata snail	*Valvata utahensis*
THREATENED SPECIES	
Ute ladies'-tresses	*Spiranthes diluvialis*
CANDIDATE SPECIES	
Ferruginous hawk	*Buteo regalis*
Western snowy plover	*Charadrius alexandrinus nivosus*
Loggerhead shrike	*Lanius ludovicianus*
Whitefaced ibis	*Plegadis chichi*
Black tern	*Chlidonias niger*
Western least bittern	*Ixobrychus exilis hesperis*
Spotted bat	*Euderma maculatum*
Spotted frog	*Rana pretiosa*
Utah hydroporus diving beetle	*Hydroporus utahensis*
Leatherside chub	*Gila copei*
Bonneville cutthroat trout	*Oncorhynchus (Salmo) clarki utah*
Utah physa (= Utah bubble snail)	*Physella (= Physa) utahensis*
Thickshell pondsnail (= Utah band snail)	*Stagnicola utahensis (= Lymnaea kingii)*

FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES WITHIN THE WASATCH COUNTY WATER EFFICIENCY PROJECT AREA

COMMON NAME	SCIENTIFIC NAME
ENDANGERED SPECIES	
Bald eagle	*Haliaeetus leucocephalus*
Peregrine falcon	*Falco peregrinus*
Whooping crane	*Grus americanus*
June sucker	*Chasmistes liorus*
Utah valvata snail	*Valvata utahensis*
Colorado squawfish	*Ptychocheilus lucius*
Bonytail chub	*Gila elegans*
Humpback chub	*Gila cypha*
Razorback sucker	*Xyrauchen texanus*
THREATENED SPECIES	
Ute ladies'-tresses	*Spiranthes diluvialis*
CANDIDATE SPECIES	
Northern goshawk	*Accipiter gentilis*
Ferruginous hawk	*Buteo regalis*
Western snowy plover	*Charadrius alexandrinus nivosus*
Loggerhead shrike	*Lanius ludovicianus*
Whitefaced ibis	*Plegadis chichi*
Black tern	*Childonias niger*
Western least bittern	*Ixobrychus exilis hesperis*
Spotted bat	*Euderma maculatum*
North American lynx	*Felis lynx canadensis*
Spotted frog	*Rana pretiosa*
Utah hydroporus diving beetle	*Hydroporus utahensis*
Leatherside chub	*Gila copei*
Bonneville cutthroat trout	*Oncorhynchus (Salmo) clarki utah*
Flannelmouth sucker	*Catostomus latipinnis*
Roundtail chub	*Gila robusta*

Utah physa (=Utah bubble snail)	*Physella (=Physa) utahensis*
Thisckshell pondsnail (=Utah band snail)	*Stagnicola utahensis (=Lymnaea kingii)*

mb\leon
b:fivel.eon

United States Department of the Interior

FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
LINCOLN PLAZA
145 EAST 1300 SOUTH, SUITE 404
SALT LAKE CITY, UTAH 84115

NOV 1994
RECEIVED

In Reply Refer To
(ES)

November 14, 1994

Mr. Robert L. Riddle
District Ranger
Heber Ranger District
U.S. Forest Service
P.O. Box 190
Heber City, Utah 84032

Dear Mr. Riddle:

This is in response to your letter of October 6, 1994, in which you referenced your cooperative efforts with the Central Utah Water Conservancy District (CUWCD) in preparation of an EIS for the Daniel Replacement/Wasatch County Water Efficiency Project (DR\WCWEP). Your letter advised us that the Forest Service wishes to prepare a biological assessment for the Forest Service's portion of the proposed action. Your letter included a map that delineates locations of the Forest Service's proposed action in the upper Strawberry River drainage. For purposes of consultation in accordance with the Endangered Species Act, we believe it is appropriate to define the area for consultation on the DR/WCWEP as encompassing Utah Lake; the Provo River between Utah Lake and Deer Creek Reservoir; Deer Creek Reservoir; other areas of Heber Valley between Deer Creek and Jordanelle reservoirs, bounded on the east by the Timpanogos Canal and on the west by Snake Creek and River Ditch; areas that will be affected by plans for restoration of historic streamflows in the upper Strawberry River (including Daniels Creek, the upper Strawberry River and other affected tributary streams); Strawberry Reservoir; streams of the Uinta River that will receive water that will no longer be diverted to Daniels Creek; and downstream aquatic habitats of the Duchesne and Green rivers.

Enclosed is a list of threatened and endangered species for the project. We are also including a list of candidate species for your review and consideration (enclosed). Because this is a cooperative project with the CUWCD, the enclosed species lists are identical to the lists provided to the CUWCD on August 16, 1994. We suggest you contact Mr. Harold Sersland, CUWCD, to coordinate responses to species lists provided for the DR/WCWEP.

Critical habitat for the June sucker was designated in Federal Register Vol. 51, No. 61 on March 31, 1986, and critical habitat for the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker were designated in Federal Register / Vol. 59, No. 54 on March 21, 1994.

Species that are candidates for official listing are identified in Federal Register Vol. 58 / No. 188, dated September 30, 1993, and Federal Register Vol. 56 / No. 225, dated November 21, 1993. All of the Candidate Species except the spotted frog in the enclosed lists are Category 2 Candidates. The spotted frog is a Category 1 Candidate. The Fish and Wildlife Service's 12-month petition finding on the spotted frog was published in Federal Register / Vol. 58 / No. 87 on May 7, 1993.

The Forest Service should review their proposed action and determine if the action would affect any listed species or their critical habitat. If the determination is "may affect" for listed species and/or may destroy or adversely modify critical habitat, you must request, in writing, formal consultation from the Assistant Field Supervisor, at the address given above. At that time, you should provide this office a copy of the biological assessment and any other relevant information that assisted you in reaching your conclusion.

The Service can enter into formal Section 7 consultation only with another Federal agency. State, county, or any other governmental or private organizations can participate in the consultation process, help prepare information such as the biological assessment, participate in meetings, etc.

Your attention is also directed to Section 7(d) of the Endangered Species Act, as amended, which underscores the requirement that the Federal agency or the applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which, in effect, would deny the formulation or implementation of reasonable and prudent alternatives regarding their actions on any endangered or threatened species.

If we can be of further assistance, please advise us. The Service representative who will provide you technical assistance is Doug Young (801 524-5001).

Sincerely,

Reed E. Harris

Reed E. Harris
Field Supervisor

Enclosures

cc: Director, Utah Division of Wildlife Resources, 1596 West North Temple, Salt Lake City, Utah 84116
Regional Supervisor, Central Region (Attn: John Fairchild), Utah Division of Wildlife Resources, 115 North Main Street, Springville, Utah 84663
Mr. Bob Hurley, CUP Liaison Officer, Uinta National Forest, 88 West 100 North, P.O. Box 1428, Provo, Utah 84603
Mr. P. Kirk Carpenter, Central Utah Water Conservancy District, 355 West 1300 South, Orem, Utah 84058-7303
Mr. Harold Sersland, Environmental Programs Manager, Central Utah Water Conservancy District, 355 West 1300 South, Orem, Utah 84058-7303
Mr. Ronald Johnston, CUP Completion Act Program Director, U.S. Department of the Interior, P.O. Box 51338, Provo, Utah 84605
Assistant Regional Director (Attn: Grady Towns), Ecological Services, U.S. Fish and Wildlife Service, Denver Federal Center, Denver Colorado / Mail Stop 60120

FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES WITHIN THE PROVO RIVER/WASATCH COUNTY WATER EFFICIENCY PROJECT AREA

COMMON NAME	SCIENTIFIC NAME
ENDANGERED SPECIES	
Bald eagle	*Haliaeetus leucocephalus*
Peregrine falcon	*Falco peregrinus*
Whooping crane	*Grus americanus*
June sucker	*Chasmistes liorus*
Utah valvata snail	*Valvata utahensis*
Colorado squawfish	*Ptychocheilus lucius*
Bonytail chub	*Gila elegans*
Humpback chub	*Gila cypha*
Razorback sucker	*Xyrauchen texanus*
THREATENED SPECIES	
Ute ladies'-tresses	*Spiranthes diluvialis*
CANDIDATE SPECIES	
Northern goshawk	*Accipiter gentilis*
Ferruginous hawk	*Buteo regalis*
Western snowy plover	*Charadrius alexandrinus nivosus*
Loggerhead shrike	*Lanius ludovicianus*
Whitefaced ibis	*Plegadis chichi*
Black tern	*Childonias niger*
Western least bittern	*Ixobrychus exilis hesperis*
Spotted bat	*Euderma maculatum*
North American lynx	*Felis lynx canadensis*
Spotted frog	*Rana pretiosa*
Utah hydroporus diving beetle	*Hydroporus utahensis*
Leatherside chub	*Gila copei*
Bonneville cutthroat trout	*Oncorhynchus (Salmo) clarki utah*
Flannelmouth sucker	*Catostomus latipinnis*
Roundtail chub	*Gila robusta*

Utah physa (=Utah bubble snail)	*Physella (=Physa) utahensis*
Thisckshell pondsnail (=Utah band snail)	*Stagnicola utahensis (=Lymnaea kingii)*

PUBLIC HEARINGS REGISTRATION FORM

Please note: The public hearings will include both the Wasatch County Water Efficiency Project/Daniel Replacement Project and the Provo River Restoration Project. Each project should be addressed **separately**. Testimony may be given on each of the two projects but should be made and identified as two separate presentations. Verbal testimony will be limited to 5 minutes for each DEIS. In order to be included as part of the hearing record, written testimony must be submitted at the time of the hearing. Registration forms should be submitted to the Central Utah Water Conservancy District office by July 15, 1996.

Presenter: ______________________________

Address: ______________________________

City, State, Zip: ______________________________

Representing: ______________________________

I wish to appear at the (choose one):

Salt Lake City (July 16 - 6:30 pm) Salt Lake County Commission Chambers 2001 South State Street, Room N1100 Salt Lake City, UT	or	Heber City (July 17 - 6:00 pm) Wasatch County Middle School 800 South 200 East Heber City, UT

public hearing to express my views on the adequacy or accuracy of the Draft Environmental Impact Statement(s) for the:

Wasatch County Water Efficiency Project and Daniel Replacement Project

and/or the

Provo River Restoration Project

____
Signature

Forms also will be accepted at the door prior to each hearing.

Please address registration forms to:

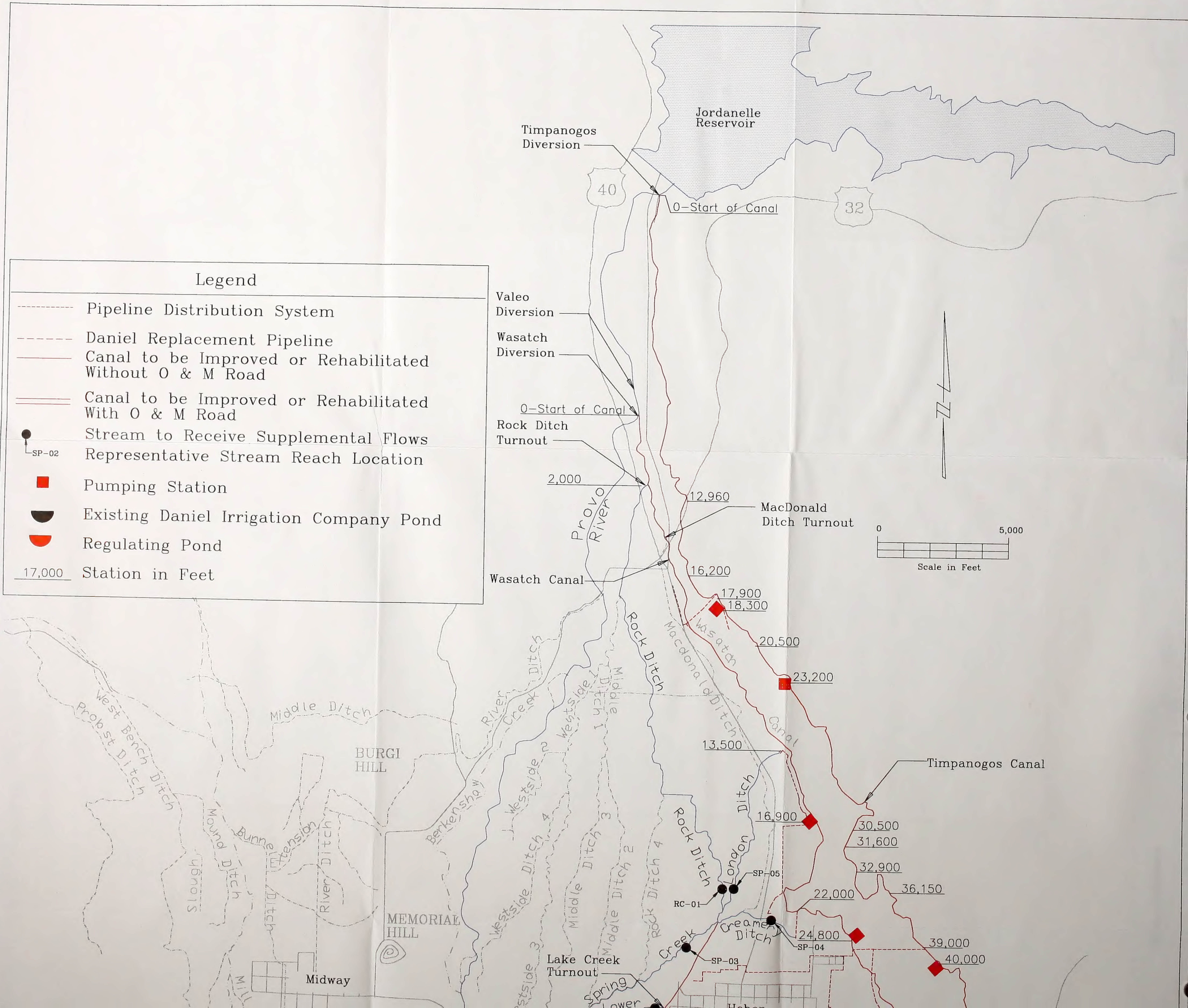
Nancy Hardman
Central Utah Water Conservancy District
355 West 1300 South
Orem, UT 84058-7303

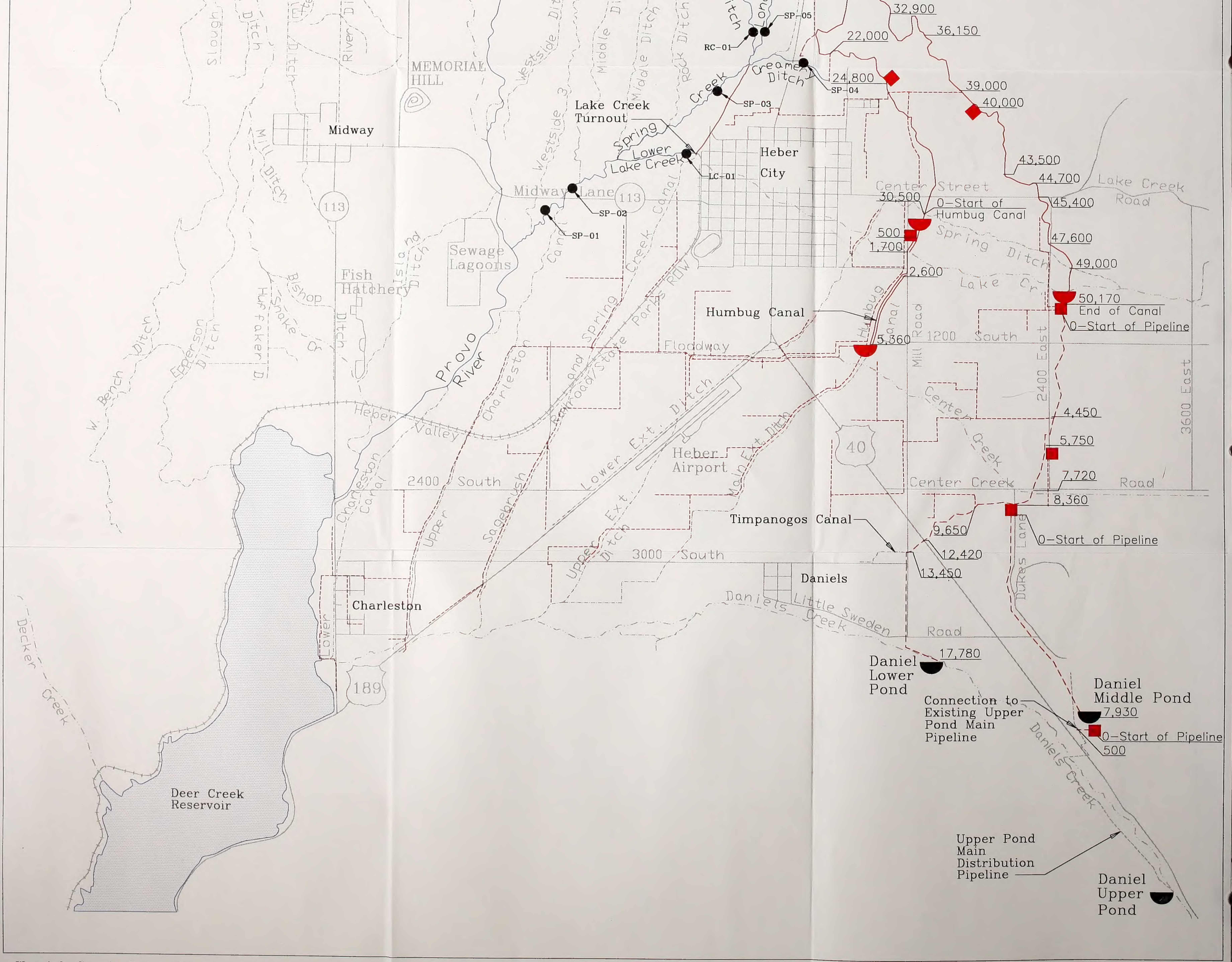
Telephone: (801) 226-7187
Fax: (801) 226-7150

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

Map A-1

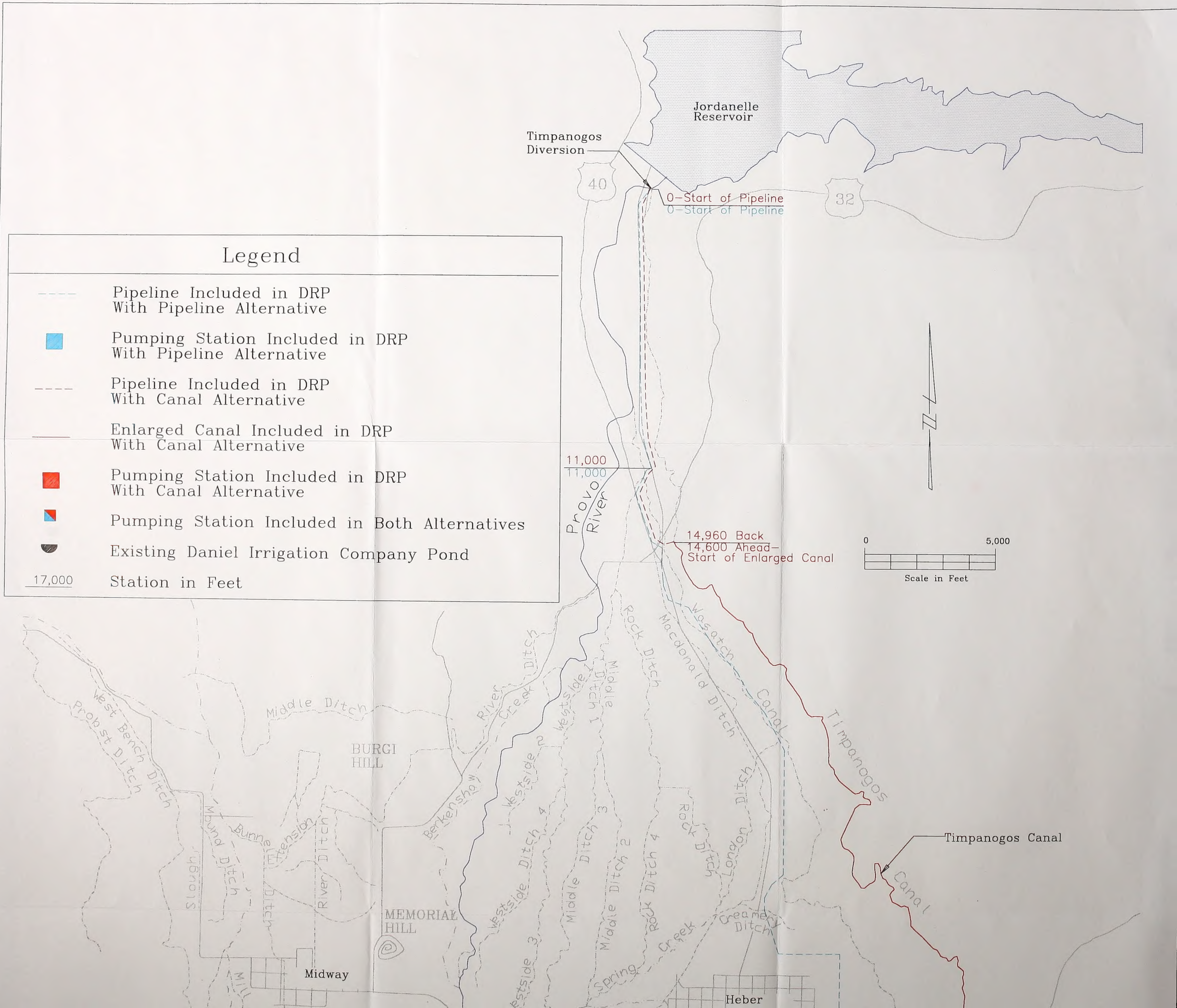
Map A-2

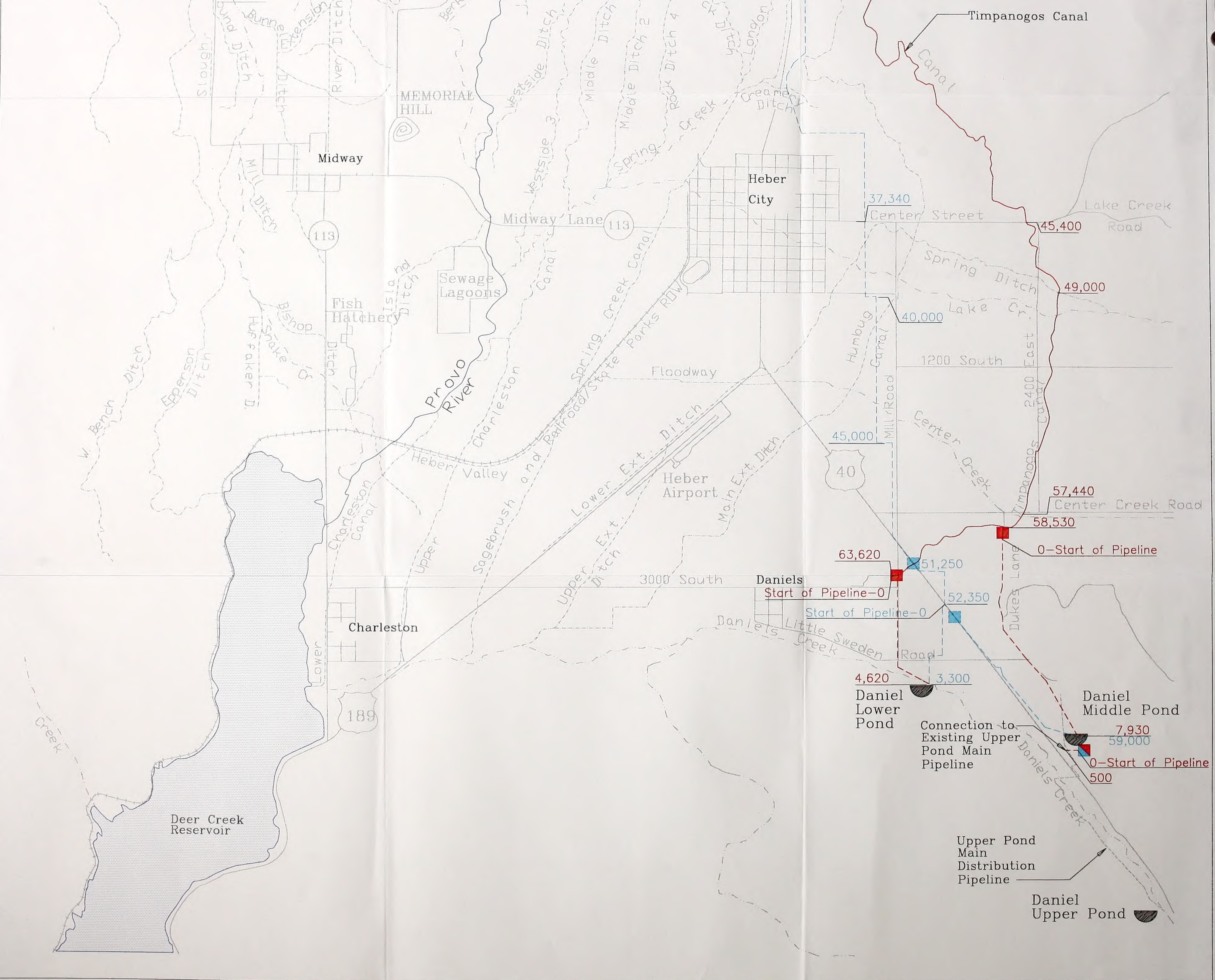

Legend
Pipeline Distribution System
Daniel Replacement Pipeline
Canal to be Improved or Rehabilitated Without O & M Road
Canal to be Improved or Rehabilitated With O & M Road
Stream to Receive Supplemental Flows
SP-02 Representative Stream Reach Location
Pumping Station
Existing Daniel Irrigation Company Pond
Regulating Pond
17,000 Station in Feet
Jordanelle Reservoir
Timpanogos Diversion
40
32
0-Start of Canal
Valeo Diversion
Wasatch Diversion
0-Start of Canal
Rock Ditch Turnout
2,000
12,960
MacDonald Ditch Turnout
Provo River
Wasatch Canal
16,200
17,900
18,300
20,500
23,200
0
5,000
Scale in Feet
N
Rock Ditch
Macdonald Ditch
Wasatch Canal
13,500
Timpanogos Canal
16,900
30,500
31,600
32,900
36,150
22,000
24,800
39,000
40,000
London Ditch
Rock Ditch
SP-05
RC-01
SP-04
SP-03
Creamery Ditch
Creek
Lake Creek Turnout
Spring
Lower
Heber
Midway
MEMORIAL HILL
BURGI HILL
Middle Ditch
River Ditch
Creek Ditch
Berkenshaw
Westside 1
Westside 2
Westside 4
Westside 3
Westside Ditch
Middle Ditch 1
Middle Ditch 2
Middle Ditch 3
Middle Ditch
Rock Ditch 4
West Bench Ditch
Probst Ditch
Mound Ditch
Bunnel Extension
Ditch
River Ditch
Slough
Mill



Wasatch County Water Efficiency Project and Daniel Replacement Project

Map A-1
Location of Major Physical Features of the Proposed Action
(WCWEP with Daniel Replacement Pipeline)


Legend
Pipeline Included in DRP With Pipeline Alternative
Pumping Station Included in DRP With Pipeline Alternative
Pipeline Included in DRP With Canal Alternative
Enlarged Canal Included in DRP With Canal Alternative
Pumping Station Included in DRP With Canal Alternative
Pumping Station Included in Both Alternatives
Existing Daniel Irrigation Company Pond
17,000 Station in Feet
Jordanelle Reservoir
Timpanogos Diversion
40
32
0–Start of Pipeline
0–Start of Pipeline
11,000
11,000
Provo River
14,960 Back
14,600 Ahead–
Start of Enlarged Canal
0
5,000
Scale in Feet
N
Rock Ditch
Macdonald Ditch
Wasatch Canal
Timpanogos
Timpanogos Canal
Canal
Middle Ditch
River Creek Ditch
Westside 1 Ditch
Middle 1 Ditch
Westside 2
Westside 4
Westside Ditch 4
Westside 3
Middle Ditch 3
Middle Ditch 2
Rock Ditch 4
Rock Ditch
London Ditch
Spring Creek
Creamery Ditch
West Bench Ditch
Probst Ditch
BURGI HILL
Berkenshow
Bunnel Extension
Mound Ditch
Slough
River Ditch
Ditch
MEMORIAL HILL
Midway
Mill
Heber

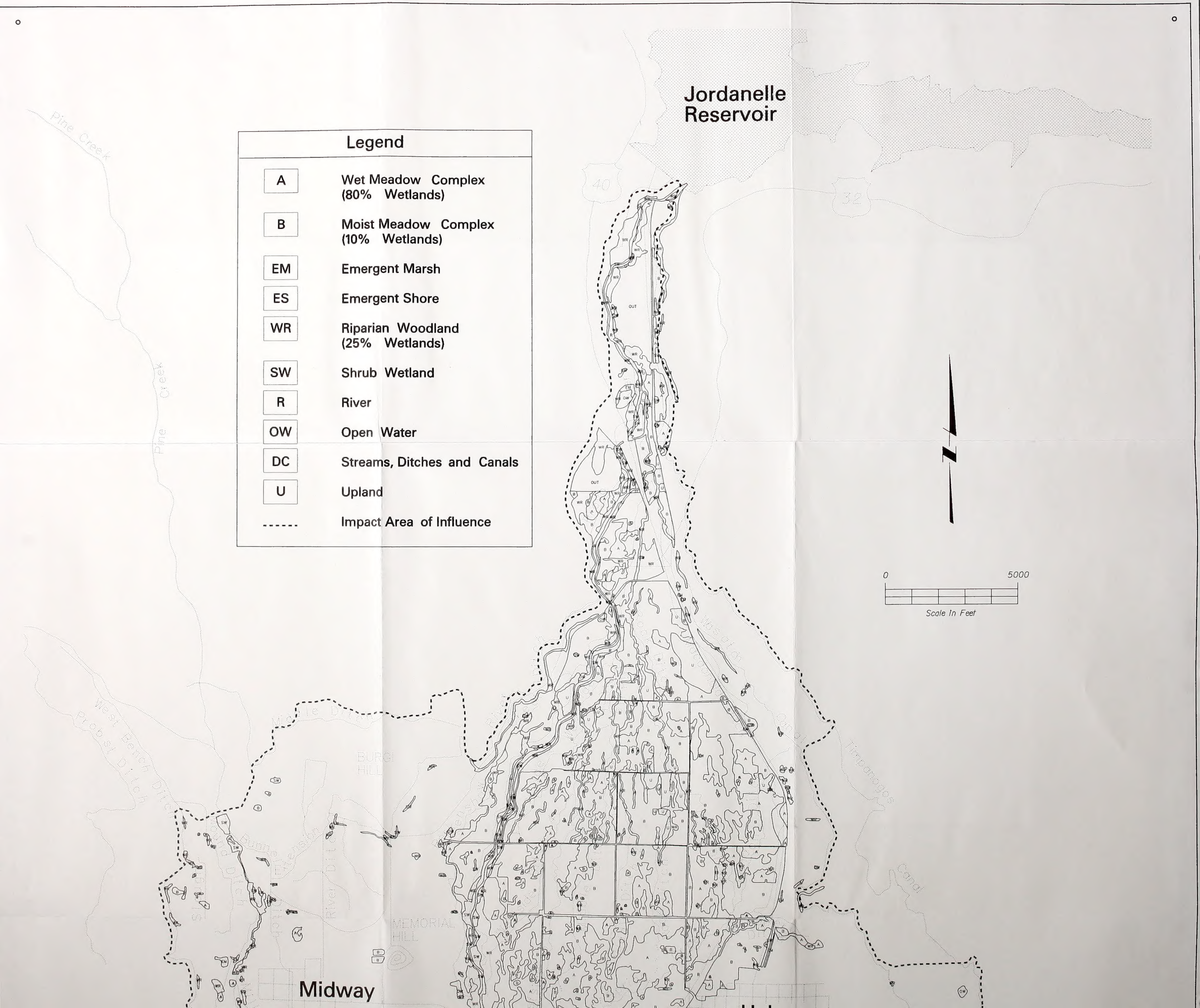


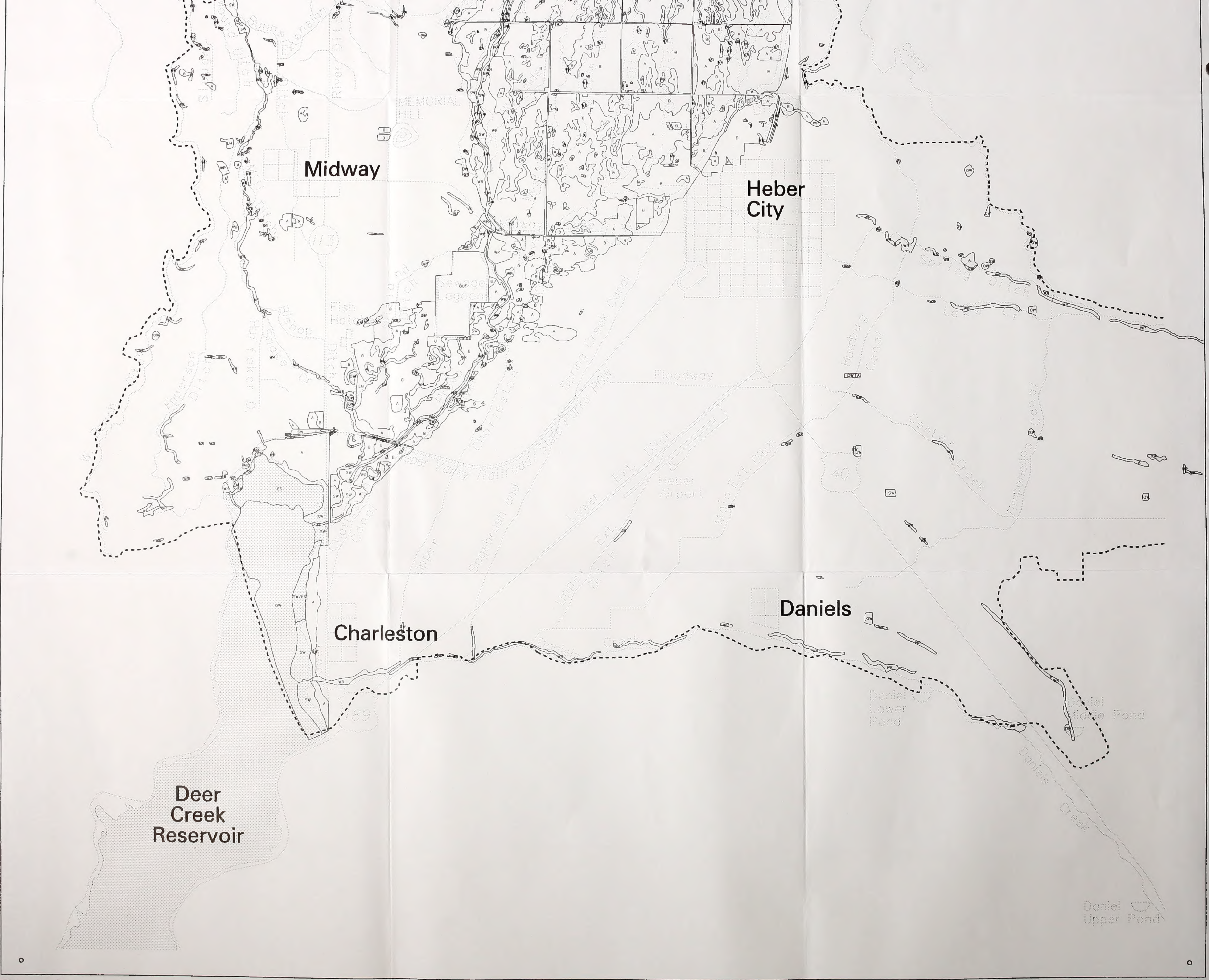
Wasatch County Water Efficiency Project and Daniel Replacement Project

Map A-2
Location of Major Physical Features of the
Daniel Replacement Project Alternatives

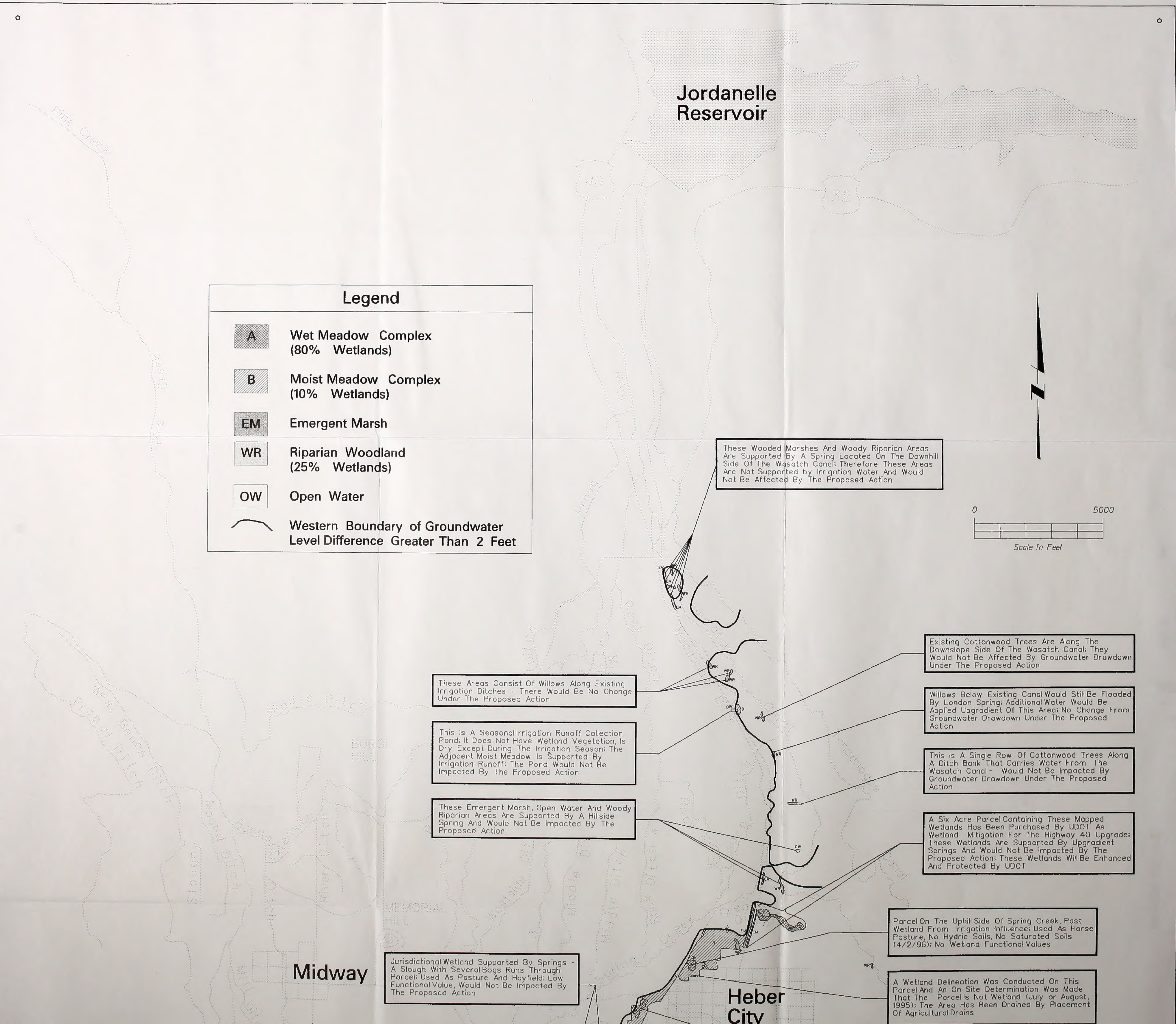
Map A-3

Map A-4


Jordanelle Reservoir
Legend
A Wet Meadow Complex (80% Wetlands)
B Moist Meadow Complex (10% Wetlands)
EM Emergent Marsh
ES Emergent Shore
WR Riparian Woodland (25% Wetlands)
SW Shrub Wetland
R River
OW Open Water
DC Streams, Ditches and Canals
U Upland
Impact Area of Influence
Pine Creek
Pine Creek
West Bench Ditch
Probst Ditch
Middle Ditch
BURGI HILL
MEMORIAL HILL
Timpanogos
Canal
Midway
40
32
OUT
0
5000
Scale In Feet



Map A-3
Existing Wetlands Mapped in Heber Valley



Legend

A	Wet Meadow Complex (80% Wetlands)
B	Moist Meadow Complex (10% Wetlands)
EM	Emergent Marsh
WR	Riparian Woodland (25% Wetlands)
OW	Open Water
⌒	Western Boundary of Groundwater Level Difference Greater Than 2 Feet

These Wooded Marshes And Woody Riparian Areas Are Supported By A Spring Located On The Downhill Side Of The Wasatch Canal; Therefore These Areas Are Not Supported by Irrigation Water And Would Not Be Affected By The Proposed Action

These Areas Consist Of Willows Along Existing Irrigation Ditches - There Would Be No Change Under The Proposed Action

This Is A Seasonal Irrigation Runoff Collection Pond; It Does Not Have Wetland Vegetation, Is Dry Except During The Irrigation Season; The Adjacent Moist Meadow Is Supported By Irrigation Runoff; The Pond Would Not Be Impacted By The Proposed Action

These Emergent Marsh, Open Water And Woody Riparian Areas Are Supported By A Hillside Spring And Would Not Be Impacted By The Proposed Action

Jurisdictional Wetland Supported By Springs - A Slough With Several Bogs Runs Through Parcel; Used As Pasture And Hayfield; Low Functional Value, Would Not Be Impacted By The Proposed Action

Existing Cottonwood Trees Are Along The Downslope Side Of The Wasatch Canal; They Would Not Be Affected By Groundwater Drawdown Under The Proposed Action

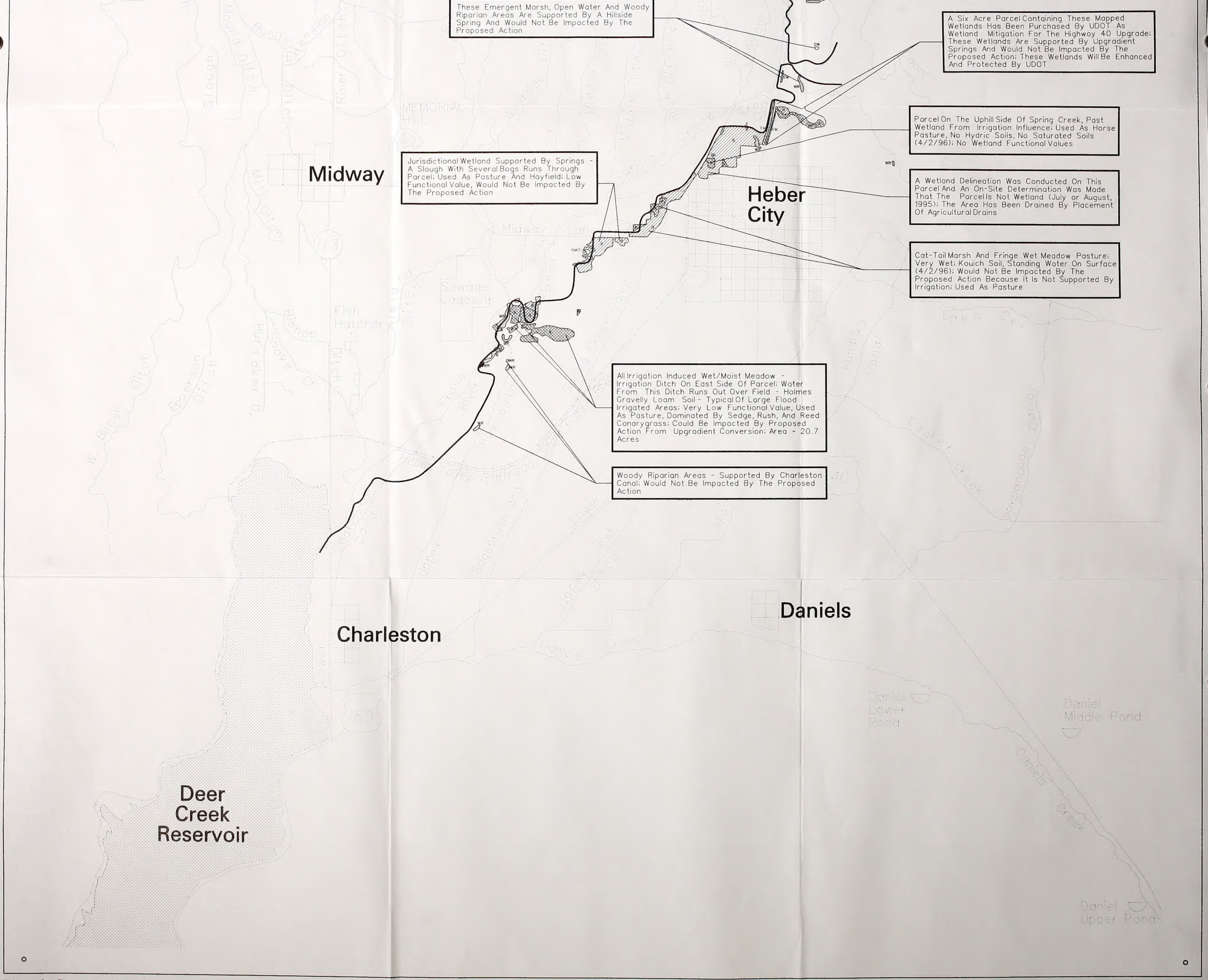
Willows Below Existing Canal Would Still Be Flooded By London Spring; Additional Water Would Be Applied Upgradient Of This Area; No Change From Groundwater Drawdown Under The Proposed Action

This Is A Single Row Of Cottonwood Trees Along A Ditch Bank That Carries Water From The Wasatch Canal - Would Not Be Impacted By Groundwater Drawdown Under The Proposed Action

A Six Acre Parcel Containing These Mapped Wetlands Has Been Purchased By UDOT As Wetland Mitigation For The Highway 40 Upgrade; These Wetlands Are Supported By Upgradient Springs And Would Not Be Impacted By The Proposed Action; These Wetlands Will Be Enhanced And Protected By UDOT

Parcel On The Uphill Side Of Spring Creek, Past Wetland From Irrigation Influence; Used As Horse Pasture, No Hydric Soils, No Saturated Soils (4/2/96); No Wetland Functional Values

A Wetland Delineation Was Conducted On This Parcel And An On-Site Determination Was Made That The Parcel Is Not Wetland (July or August, 1995); The Area Has Been Drained By Placement Of Agricultural Drains



These Emergent Marsh, Open Water And Woody Riparian Areas Are Supported By A Hillside Spring And Would Not Be Impacted By The Proposed Action

A Six Acre Parcel Containing These Mapped Wetlands Has Been Purchased By UDOT As Wetland Mitigation For The Highway 40 Upgrade; These Wetlands Are Supported By Upgradient Springs And Would Not Be Impacted By The Proposed Action; These Wetlands Will Be Enhanced And Protected By UDOT

Parcel On The Uphill Side Of Spring Creek, Past Wetland From Irrigation Influence; Used As Horse Pasture, No Hydric Soils, No Saturated Soils (4/2/96); No Wetland Functional Values

Jurisdictional Wetland Supported By Springs - A Slough With Several Bogs Runs Through Parcel; Used As Pasture And Hayfield; Low Functional Value, Would Not Be Impacted By The Proposed Action

A Wetland Delineation Was Conducted On This Parcel And An On-Site Determination Was Made That The Parcel Is Not Wetland (July or August, 1995); The Area Has Been Drained By Placement Of Agricultural Drains

Cat-Tail Marsh And Fringe Wet Meadow Pasture; Very Wet; Kouich Soil, Standing Water On Surface (4/2/96); Would Not Be Impacted By The Proposed Action Because It Is Not Supported By Irrigation; Used As Pasture

All Irrigation Induced Wet/Moist Meadow - Irrigation Ditch On East Side Of Parcel; Water From This Ditch Runs Out Over Field - Holmes Gravelly Loam Soil - Typical Of Large Flood Irrigated Areas; Very Low Functional Value, Used As Pasture, Dominated By Sedge, Rush, And Reed Canarygrass; Could Be Impacted By Proposed Action From Upgradient Conversion; Area = 20.7 Acres

Woody Riparian Areas - Supported By Charleston Canal; Would Not Be Impacted By The Proposed Action

Map A–4
Wetland Impacts From Groundwater
Drawdown Under the Proposed Action
(WCWEP With Daniel Replacement Pipeline)

Map A-5

Map A-6

Map A-7

Map A-8

Legend
Existing Provo River
Proposed Realigned Channel
Public Ownership (State or Federal)
Proposed Wetland Mitigation Property
Proposed Dike
Distance in Feet Along Channel Centerline (Starting at 000' at Beginning of Reach)
Proposed Property Acquisition Boundary
Proposed Pond:
Open Water
Emergent Vegetation Zone
Proposed Side Channel
100-Year Floodplain Boundary
Notes:
1. All Existing Dikes will be Removed Except Where Noted.
2. All Existing Bridges and Pipelines to Remain in Place will be Protected.
North is to the Right
0 500
Scale In Feet
A
DIRECTION OF FLOW
Deer Creek Reservoir Right-Of-Way Boundary
Heber Valley Railroad/ State Parks ROW
Construct 2-ft High Setback Dike
Winterton Bridge
Existing Provo River
Fill Abandoned Channel
Casper Bridge
Casperville Road
Relocated Lower Charleston Diversion
Private Pond (Existing)
Retain Existing Dike
Relocated Irrigation Ditch
Relocated Everett Slough Diversion
Wastewater Treatment Plant
Spring Creek
Island Ditch Diversion
Midway Road
Continued Panel B, Left Side
REACH 1
REACH 2
REACH 3
REACH 4
B
Existing Pond
Connect To Existing Irrigation Ditch
Construct 2-ft High Setback Dike
Probst Diversion
Construct New Culvert
Construct 3-ft High Setback Dike
River Road
Relocated Wilson Diversion
Relocated Gertsch Diversion
Continued From Panel A
Continued Panel C, Left Side
REACH 5
REACH 6
REACH 7
C
Relocated Limit of Constructed Wetland
Relocate Existing Wetland Water Supply Pipeline
Buried Grade Control Structure
Highway 40
Baum Diversion
All Land North (to the right) of this Boundary is Federally Owned
Wasatch Canal Return Channel
Wasatch Canal
Retain Existing Dike
Relocated Wasatch Diversion
Valeo Canal New Dike
Condie Pond (Existing)
Construct New Pipeline
Relocated Condie Diversion
Private Bridge
Old U.S. 40 & 189
Campground
Continued From Panel B
River Road
REACH 8
REACH 9

Provo River Restoration Project

Map A-5
Major Features of the Proposed Action
(Riverine Habitat Restoration)

Provo River Restoration Project

Map A–6
Major Features of the Existing Channel Modification Alternative

Legend
Existing Provo River
Proposed Realigned Channel
Public Ownership (State or Federal)
Proposed Wetland Mitigation Property
Proposed Dike
Distance in Feet Along Channel Centerline (Starting at 000' at Beginning of Reach)
Proposed Property Acquisition Boundary
Proposed Pond:
Open Water
Emergent Vegetation Zone
Proposed Side Channel
Parcel Boundary
Proposed Construction Easement
Proposed Flood Only Easement Areas
Notes:
1. All Existing Dikes will be Removed Except Where Noted.
2. All Existing Bridges and Pipelines to Remain in Place will be Protected.
North is to the Right
0 500
Scale In Feet
A
DIRECTION OF FLOW
Deer Creek Reservoir Right-Of-Way Boundary
Heber Valley Railroad/ State Parks ROW
Winterton Bridge
Existing Provo River
Fill Abandoned Channel
Casper Bridge
Casperville Road
Private Pond (Existing)
Wastewater Treatment Plant
Island Ditch Diversion
Midway Road
Snake Creek
Continued Panel B, Left Side
REACH 1
REACH 2
REACH 3
B
Existing Pond
Connect To Existing Irrigation Ditch
Probst Diversion
River Road
REACH 4
REACH 5
REACH 6
REACH 7
Continued From Panel A
Continued Panel C, Left Side
C
Continued From Panel B
Baum Diversion
Highway 40
Wasatch Canal
Wasatch Canal Return Channel
Valeo Canal
Candle Pond (Existing)
Private Bridge
Old U.S. 40 & 189
Campground
REACH 8
REACH 9
All Land North (to the right) of this Boundary is Federally Owned

Map A–7
Property Acquisition Under the Proposed Action
(Riverine Habitat Restoration)

Legend
Existing Provo River
Proposed Realigned Channel
Public Ownership (State or Federal)
Proposed Wetland Mitigation Property
Proposed Dike
000' 500'
Distance in Feet Along Channel Centerline (Starting at 000' at Beginning of Reach)
Proposed Public Access Boundary
Parcel Boundary
Proposed Construction Easement
North is to the Right
0 500
Scale In Feet
A
DIRECTION OF FLOW
Deer Creek Reservoir Right-Of-Way Boundary
Heber Valley Railroad/ State Parks ROW
Winterton Bridge
Existing Provo River
Casper Bridge
Casperville Road
Private Pond (Existing)
Wastewater Treatment Plant
Spring Creek
Midway Road
REACH 2
REACH 3
REACH 4
Continued Panel B, Left Side
B
Existing Pond
River Road
REACH 5
REACH 6
REACH 7
Continued Panel C, Left Side
Continued From Panel A
C
Continued From Panel B
River Road
Highway 40
Private Bridge
Candle Pond (Existing)
Wasatch Canal
Wasatch Canal Return Channel
Valeo Canal
Old U.S. 40 & 189
Campground
REACH 8
REACH 9
All Land North (to the right) of this Boundary is Federally Owned

Provo River Restoration Project

Map A-8
Property Acquisition Under the
Existing Channel Modification Alternative

Map A-9

Map A-10

Map A-11

Map A–9
Flooded Areas Under the Proposed Action
(Riverine Habitat Restoration)

Legend
Existing Provo River
Proposed Realigned Channel
Public Ownership (State or Federal)
Proposed Wetland Mitigation Property
Constructed Wetland
New Dike
000' 500' Distance in Feet Along Channel Centerline (Starting at 000' at Beginning of Each Reach)
(+) Positive Impacts* (26.2 Acres, Ponds and Side Channels)
Open Water Pond With Emergent Marsh
Constructed Side Channel
(–) Negative Impacts (74.2 Acres)
Wetland Impacts
Bureau of Reclamation Wetland Impacts
Floodplain Construction
* 256.5 Acres Riparian Woodland - Not Shown
North is to the Right
0 500
Scale In Feet
A
Wetland Impact Acreage By Reach
Reach 2 = 3.6 Acres (-)
3.7 Acres (+)
Reach 3 = 4.8 Acres (-)
1.7 Acres (+)
Reach 4 = 12.8 Acres (-)
2.7 Acres (+)
REACH 1
REACH 2
Winterton Bridge
Existing Provo River
Deer Creek Reservoir Right-Of-Way Boundary
Heber Valley Railroad/ State Parks ROW
Floodplain Construction - Wet Meadow = 0.8 Acre (-)
New Dike Moist Meadow = 0.1 Acre (-)
Reach 2 Side Channel Length = 3979' 1.2 Acres (+)
New Dike Moist Meadow = 0.04 Acre (-)
Floodplain Construction - Moist Meadow = 0.1 Acre (-)
Floodplain Construction - Moist Meadow = 0.1 Acre (-)
New Dike Moist Meadow = 0.06 Acre (-)
Reach 3 Side Channel Length = 5600' 1.6 Acres (+)
Reach 3 Moist Meadow = 0.21 Acre (-)
New Dike Wet Meadow = 0.5 Acre (-)
Wet Meadow = 1.9 Acres (-)
Wet Meadow = 1.2 Acres (-)
Wet Meadow = 0.6 Acre (-)
Open Water = 0.6 Acre (+)
Emergent Marsh = 0.5 Acre (+)
Reach 2 Side Channel Length = 4995' 1.4 Acres (+)
Casper Bridge
Wet Meadow = 0.6 Acres (-)
Casperville Road
Existing Provo River
REACH 3
REACH 2
Reach 2 Wet Meadow = 0.04 Acre (-)
Private Pond (Existing)
Existing Provo River
DIRECTION OF FLOW
Wastewater Treatment Plant
Riparian Woodland = 1.0 Acre (-)
Spring Creek
Reach 3 Side Channel Length = 430' 0.1 Acre (+)
Riparian Woodland = 1.7 Acres (-)
New Dike Riparian Woodland = 0.7 Acre (-)
Existing Provo River
Midway Road
REACH 4
REACH 3
Riparian Woodland = 1.3 Acres (-)
Floodplain Construction - Shrub = 2.0 Acres (-)
Riparian Woodland = 1.3 Acres (-)
Floodplain Construction - Shrub = 2.3 Acres (-)
Reach 4 Side Channel Length = 1662' 0.5 Acre (+)
Continued Panel B, Left Side
B
Wetland Impact Acreage By Reach
Reach 5 = 2.8 Acres (-)
2.4 Acres (+)
Reach 6 = 3.0 Acres (-)
8.3 Acres (+)
Continued From Panel A
Existing Pond
Existing Provo River
Reach 4 Side Channel Length = 1253' 0.3 Acre (+)
Existing Pond
Riparian Woodland = 2.8 Acres (-)
Reach 4 Side Channel Length = 3408' 1.0 Acre (+)
Riparian Woodland = 2.1 Acres (-)
Open Water = 0.5 Acre (+)
Emergent Marsh = 0.4 Acre (+)
Shrub Wetland = 0.3 Acre (-)
Floodplain Construction - Wet Meadow = 3.6 Acres (-)
REACH 5
REACH 4
Wet Meadow = 1.4 Acres (-)
Floodplain Grading - Wet Meadow = 1.6 Acres (-)
Floodplain Construction - Wet Meadow = 0.8 Acre (-)
Reach 5 Side Channel Length = 423' 0.1 Acre (+)
Open Water = 0.3 Acre (+)
Emergent Marsh = 0.5 Acre (+)
Wet Meadow = 1.2 Acres (-)
Moist Meadow = 2.4 Acres (-)
Connect to Existing Ditch
Emergent Marsh = 1.3 Acres (-)
Riparian Woodland = 15-16 Cottonwood Trees (-)
Reach 5 Side Channel Length = 1309' 0.4 Acre (+)
New Dike No Wetland Impacts
REACH 6
REACH 5
New Dike No Wetland Impacts
Riparian Woodland = 0.4 Acre (-)
Reach 5 Side Channel Length = 3726' 1.1 Acres (+)
Open Water = 0.6 Acre (+)
Emergent Marsh = 0.5 Acre (+)
Floodplain Construction No Wetland Impacts
Reach 6 Side Channel Length = 1057' 0.3 Acre (+)
New Dike No Wetland Impacts
Floodplain Construction No Wetland Impacts
Existing Provo River
Open Water = 0.9 Acre (+)
Emergent Marsh = 0.4 Acre (+)
Open Water = 0.7 Acre (+)
Emergent Marsh = 0.4 Acre (+)
River Road
Reach 6 Side Channel Length = 2216' 0.6 Acre (+)
Floodplain Construction No Wetland Impacts
New Dike Moist Meadow = 1.2 Acres (-)
Reach 6 Side Channel Length = 13,469' 3.9 Acres (+)
Existing Provo River
Floodplain Construction - Wet Meadow = 1.6 Acres (-)
REACH 7
REACH 6
Continued Panel C, Left Side
DIRECTION OF FLOW
C
Wetland Impact Acreage By Reach
Reach 7 = 14.4 Acres (-)
1.2 Acres (+)
Reach 8 = 3.7 Acres (-)
• Bureau of Reclamation Replacement Wetlands = 12.4 Acres (-)
5.1 Acres (+)
Reach 9 = 3.0 Acres (-)
• Bureau of Reclamation Replacement Wetlands = 13.7 Acres (-)
1.1 Acres (+)
Continued From Panel B
River Road
Reach 7 Side Channel Length = 680' 0.2 Acre (+)
Emergent Marsh = 2.0 Acres (-)
Wet Meadow = 1.0 Acre (-)
Wet Meadow = 1.2 Acres (-)
Existing Provo River
Floodplain Construction - Wet Meadow = 2.7 Acres (-)
New Dike Wet Meadow = 2.4 Acres (-)
Floodplain Construction - Wet Meadow = 1.4 Acres (-)
Wet Meadow = 3.7 Acre (-)
Reach 7 Side Channel Length = 1510' 0.4 Acre (+)
Reach 7 Side Channel Length = 1851' 0.6 Acre (+)
Wet Meadow = 0.1 Acre (-)
Reach 8 Side Channel Length = 4352' 1.3 Acres (+)
Open Water = 1.2 Acres (+)
Emergent Marsh = 0.8 Acre (+)
All Land North (to the right) of this Boundary is Federally Owned
REACH 7
REACH 8
Wasatch Canal Return Channel
Wet Meadow = 0.3 Acre (-)
Bureau of Reclamation Wetlands = 4.4 Acres (-)
Wet Meadow = 0.3 Acre (-)
Bureau of Reclamation Wetlands = 7.4 Acres (-)
Reach 8 Wet Meadow = 2.0 Acres (-)
Bureau of Reclamation Wetlands = 0.6 Acre (-)
Highway 40
Existing Provo River
Wasatch Canal
New Dike Wet Meadow = 0.3 Acre (-)
Valeo Canal
Riparian Woodland = 0.2 Acre (-)
New Dike
REACH 9
REACH 8
Reach 8 Side Channel Length = 879' 0.3 Acre (+)
Emergent Marsh = 0.8 Acre (+)
Open Water = 0.8 Acre (+)
Candle Pond (Existing)
Reach 8 Shrub Wetland = 0.5 Acre (-)
Reach 9 Shrub Wetland = 0.5 Acre (-)
Private Bridge
Reach 9 Side Channel Length = 749' 0.2 Acre (+)
Riparian Woodland = 4 Cottonwood (-) 3 Boxelder (-) 0.2 Acre (-)
Riparian Woodland = 180 Trees, 0.8 Acre (-)
Reach 9 Side Channel Length = 1556' 0.5 Acre (+)
Bureau of Reclamation Replacement Wetlands = 4.8 Acres (-)
Existing Provo River
Bureau of Reclamation Replacement Wetlands = 4.9 Acres (-)
Riparian Woodland = 30 Cottonwood Trees (-)
Emergent Marsh = 0.1 Acre (-)
Reach 9 Side Channel Length = 1560' 0.5 Acre (+)
Riparian Woodland = 120 Trees, 1.4 Acres (-)
Riparian Woodland = 34 Trees (-)
Private Bridge
Existing Provo River
Old U.S. 40 & 189
Bureau of Reclamation Replacement Wetlands = 1.2 Acres (-)
Bureau of Reclamation Replacement Wetlands = 2.8 Acres (-)
Campground
REACH 9

Map A–10
Wetland Impact Areas Under the Proposed Action
(Riverine Habitat Restoration)

Legend
Existing Provo River
Stabilized Channel Bank
Public Ownership (State or Federal)
Wetland Mitigation Property
New Dike
Floodplain Construction Impacts
Constructed Wetland
000' 500'
Distance in Feet Along Channel Centerline (Starting at 000' at Beginning of Each Reach)
North is to the Right
0 500
Scale in Feet
A
DIRECTION OF FLOW
Deer Creek Reservoir Right-Of-Way Boundary
Heber Valley Railroad/ State Parks ROW
REACH 1 REACH 2
Winterton Bridge
Existing Provo River
Reach 2
Remove Exist. W. Dike ~ 140 Cottonwood Lost
4,000' of New 2' High Setback Dike
Wet Meadow= 2.3 Acres
Floodplain Construction Riparian Woodland = 8.6 Acres
Casper Bridge
Casperville Road
Existing Provo River
Wetland Impact Acreage By Reach
Reach 2 = 10.9 Acres
Reach 3 = 13.9 Acres
REACH 2 REACH 3
Reach 3
Remove Exist. W. Dike ~ 170 Cottonwood Lost
4,400' of New 2' High Setback Dike
Wet Meadow = 2.5 Acres
Extend Everett Slough 520'
Wet Meadow = 0.1 Acre
Floodplain Construction Riparian Woodland = 2.9 Acres
Floodplain Construction Wet Meadow = 1.2 Acres
Floodplain Construction Riparian Woodland = 7.2 Acres
Private Pond (Existing)
Existing Provo River
Wastewater Treatment Plant
Spring Creek
Existing Provo River
REACH 4 REACH 3
Midway Road
Reach 4
50' Construction Corridor Assumed to Involve 1/3 of Total Reach Length
Shrub = 2.6 Acres
Continued Panel B, Left Side
B
Wetland Impact Acreage By Reach
Reach 4 = 2.6 Acres
Reach 5 = 0.0 Acres
Reach 6 = 3.6 Acres
Existing Pond
Existing Provo River
REACH 5 REACH 4
REACH 6 REACH 5
Continued From Panel A
Existing Pond
Reach 4
50' Construction Corridor Assumed to Involve 1/3 of Total Reach Length
Reach 5
No Wetland Impacts
DIRECTION OF FLOW
River Road
Existing Provo River
Reach 6
Remove Exist. W. Dike ~ 82 Cottonwood Lost
Floodplain Construction Moist Meadow = 0.52 Acres
Floodplain Construction Wet Meadow = 1.8 Acres
Existing Provo River
Reach 6
Remove Exist. E. Dike
~ 53 Cottonwood Lost
1,400' of New 3' High Setback Dike
Riparian Woodland = 1.3 Acres
REACH 7 REACH 6
Continued Panel C, Left Side
C
Wetland Impact Acreage By Reach
Reach 7 = 3.4 Acres
Reach 8 = 17.8 Acres
Reach 9 = 10.9 Acres
Reach 7 Modify East Channel Bank ~ 40 Cottonwood Lost
Reach 7
Remove Exist. W. Dike
~ 55 Cottonwood Lost
1,300' of New 2' High Setback Dike
Wet Meadow = 0.9 Acre
Continued From Panel B
River Road
Existing Provo River
Floodplain Construction Riparian Woodland = 2.5 Acres
Channel Modification and Floodplain Construction
Riparian Woodland = 6.6 Acres
Wet Meadow = 2.2 Acres
All Land North (to the right) of this Boundary is Federally Owned
REACH 7 REACH 8
Reach 8
Remove Exist. W. Dike
~ 67 Cottonwood Lost
Floodplain Construction Wet Meadow = 0.6 Acre
80' of New 2' High Setback Dike Wet Meadow = 0.1 Acre
Highway 40
Existing Provo River
Wasatch Canal Return Channel
Wasatch Canal
DIRECTION OF FLOW
Reach 8
Remove Exist. E. Dike
~ 108 Cottonwood Lost
Fill Existing Channel
Wet Meadow = 6.2 Acres
Riparian Woodland = 2.1 Acres
Valeo Canal
Condle Pond (Existing)
Existing Provo River
REACH 8 REACH 9
Reach 9
Remove Exist. W. Dike ~ 113 Cottonwood Lost
2,000' of New 2' High Setback Dike
Wet Meadow = 1.4 Acres
Private Bridge
Floodplain Construction Riparian Woodland = 4.1 Acres
Reach 9
Bank Mods.
~ 32
Cottonwood Lost
Existing Provo River
Reach 9
Remove Exist. E. Dike ~ 205 Cottonwood Lost
Construction Corridor - Riparian Woodland = 2.3 Acres
Floodplain Construction Wet Meadow = 1.7 Acres
1,000' of New 4' High Setback Dike Wet Meadow = 1.1 Acres
Floodplain Construction Wet Meadow = 0.3 Acre
Old U.S. 40 & 189
Private Bridge
Existing Provo River
Campground

Provo River Restoration Project

Map A–11
Wetland Impact Areas Under the
Existing Channel Modification Alternative